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FRUIT AND VEGETABLES.

The Industry in the Leeward and Windward Islands.

SINCE the trade agreement between Canada and the West Indies was signed in 1925 there has been a vigorous campaign in the Leeward and Windward Islands to establish a fruit and vegetables export industry. On the whole the progress achieved has been satisfactory and the industry may now be regarded as having been successfully launched. Much, however, still remains to be done before the expectations of those who have fostered the industry can be fully realised.

Although fruits and vegetables have been grown for many years in the Leeward and Windward Islands, comparatively little attention had been paid to the possibilities of developing the industry on an export basis. More recently, however, the growing demands from Canadian and other markets has made it evident that the production of fruit and vegetable commodities might become a profitable undertaking. It is now generally recognised that the successful development of a fruit and vegetable industry cannot proceed without at least three essentials: the selection, distribution and cultivation of good varieties of plants, the careful picking, grading and packing of produce and a regular service of properly equipped steamers. Fortunately for the islands concerned the first essential was in some measure afforded by the existing botanic gardens and agricultural stations. The necessary organisations for the proper marketing and disposal of produce were, however, lacking and it was not until assistance had been received from the Canadian Government, the Colonial Development Fund, the local Governments, and the Empire Marketing Board that it was possible to deal efficiently with these aspects of the industry. Each helped in its own way. The Canadian Government co-operated by arranging a regular service of properly equipped steamships. The Colonial Development Fund provided substantial financial assistance for the erection of cold storage plants in Grenada, St. Vincent, St. Lucia, Dominica, Montserrat, Nevis and St. Kitts. The local Governments encouraged the establishment of packing sheds and the formation of Peasant Bureaux for the receipt and handling of produce for export. Finally the Empire Marketing Board appointed a full time Marketing Officer "to advise on the preparation, packing and disposal of fruit and vegetables from all the islands of the two groups, to co-ordinate their exports and

to supervise in this connection the work of the local officers responsible for the various Government sheds". It may be added here that many of the measures outlined above were taken as a result of recommendations made in 1930 at the St. Lucia Fruit Conference and at the Conference of Agricultural Officers held at the Imperial College of Tropical Agriculture.

In this issue of the *Journal* we are mainly concerned with the first year's progress report on the industry, prepared by the Marketing Officer. It is worthy of note that the exports of fruit and vegetables during the period covered by the report were maintained and in some cases exceeded, in spite of hurricanes and the incidence of diseases. Another good sign is the growing interest shown by Canada in the green lime trade. The prospects of the tomato and carrot industries appear in certain of the islands to be quite favourable. Attention is drawn to the difficulties regarding the export of avocado pears, oranges and mangoes and the prospects in regard to their exports discussed. It will be noted with satisfaction that almost all the products shipped by Government Bureaux to Canada from these islands were sent to a single marketing agency. Great efforts have been made to secure uniformity in packing methods and with this object in view all kinds of packing materials have been thoroughly investigated. The valuable information collected on this subject has been disseminated amongst the agricultural officers concerned. Canning and cold storage problems have been considered but it has been found that the introduction of the former industry would be premature at the present stage.

The progress of the industry is still being hampered by the smallness of the available exports. Lack of funds has also prevented cultivators from expanding production. It will be a matter of time before the former problem can be solved satisfactorily while in regard to the latter it may be necessary to provide special credit facilities to help the small cultivator. The future of the industry depends entirely on efficient production, on as large a scale as possible: the principal object to be aimed at being bulk production, at the right time of year, of first class varieties of fruit and vegetables. Furthermore, in the hurricane areas, it will be necessary to concentrate on the production, wherever possible, of annual as against perennial crops. With the additional staff which they now have at their disposal the Departments of Agriculture should be in a better position to carry out an extensive programme of instructional and advisory work which, eventually, should accelerate the development of the industry. Horticulture, however, is a highly technical business and many difficulties remain to be overcome in the islands concerned. One of the chief difficulties will be that of diseases. In this connection a survey of the field diseases of tomatoes, recently published in the *Journal*,* has already been carried out at the Imperial College of Tropical Agriculture. In this work it has been shown that the incidence of diseases such as mosaic and wilt varied considerably according to local conditions, and it is probable that different varieties possess different degrees of resistance. Careful observations regarding the disease factor will therefore have to be made in the various islands, especially in those with a high rainfall, to determine the ultimate commercial suitability of any particular variety. Again, although information has already been obtained at the Low Temperature Research Station in Trinidad on the storage requirements of tomatoes, the detailed storage behaviour of many vegetables and fruits which might be exported from these parts still remains to be investigated.

Many other problems concerning the industry likewise await solution but it is only by making full use of all the facilities provided and perfecting his methods of production that the cultivator, on whom the industry depends, will help materially to assure future prosperity.

**Tropical Agriculture*, Vol. IX, Nos. 3 and 4.

MAIZE HYBRIDS.

Maize hybrids with *Tripsacum*.

INDUCED parthenogenesis is a possible method of obtaining homozygous strains instead of prolonged in breeding. Mangelsdorf and Reeves (*J. Her.*, Vol. 22, No. 11), attempted to produce such seeds in maize by pollinating it with a related grass, *Tripsacum dactyloides*. This species extends from the Atlantic to Texas, the Texas form used having narrower leaves and $2n=36$ chromosomes, while the Connecticut form has $2n=72$. Crossing with the Texas type was obtained by shortening the maize silks or stigmas to about two inches. By double pollination it was found that hybrid seeds develop better adjacent to normal seeds. No parthenogenetic embryos were obtained, but the hybrid seeds usually showed 38 chromosomes. In maize $n=10$, so with double fertilisation an endosperm containing $10+10+18$ chromosomes should be found. The embryos of these seeds usually had 28 chromosomes. When pollen from the tetraploid *Tripsacum* was used, seedlings were obtained with 46 chromosomes in their root tips, as expected. Most of the seeds in these crosses were abortive and shrivelled, but could be germinated on agar. From some 185,000 silks exposed to pollination, only 84 seeds matured. Certain maize varieties crossed more readily than others, and curiously enough the tetraploid *Tripsacum* was more successful than the diploid as pollinator. The hybrids more nearly resemble the male parent, especially when the tetraploid form is used. Some plants from this cross which matured are sterile in pollen and seeds. Meiosis shows 18 bivalents, presumably the *Tripsacum* chromosomes pairing with each other, and ten lagging maize chromosomes. Numerous small nuclei are formed, resulting in aborted pollen. The reciprocal cross, *Tripsacum* maize, has never succeeded. These results differ in some respects from earlier work of Collins and Kempton.—(*Nature.*, Vol. 129, No. 3259 (1932), pp. 583-584.)

PASTURE INVESTIGATIONS: TANGANYIKA TERRITORY.

By R. R. Staples,
Pasture Research Officer, Department of Veterinary Science and Animal Husbandry.

During the year, favourable progress can be reported in connection with the investigation of pasture problems in the Territory, as two officers have been added to the establishment of the Department of Veterinary Science and Animal Husbandry for this work; in addition, the Acting Director of Veterinary Services and Mrs. Hornby have continued the study of the pasture and browse plants of the Mpwapwa area (representative of the greater part of central Tanganyika). Pasture investigations have necessarily to be carried out on the spot, and, the "crop" being perennial, results are not so quickly achieved as in most agronomic experimentation. Hence the necessity for foresight and provision in order that the information will be available at the time when it is required (a point stressed by the Agricultural Adviser to the Secretary of State for the Colonies, on the occasion of his recent visit to the Territory).

Brief Survey of the Major Pasture Problems.

To enable the reader the better to understand the pasture problems of the Territory, it is perhaps advisable to stress first the following facts, which so closely affect them:—

(1) The cattle population is steadily increasing: In 1930 there were 5,170,000 head of cattle in Tanganyika Territory as compared with 1,650,282 in 1913; sheep and goats have increased in a somewhat similar proportion.

(2) The cattle areas are hedged in with "tsetse fly" (*Glossinia* spp.) infested bush, which in a number of places is even encroaching on the normal grazing areas.

(3) Climatically the greater portion of the stock areas is semi-arid with a rainfall of 20 to 35 inches and, on the whole, but indifferently suited to crop production. The rainfall is confined to a relatively short wet season and for the most part falls in torrential downpours. The soils are mostly of a light, sandy nature, and, when the natural vegetative cover is destroyed, both wind and water erosion become serious.

(4) The native will not part readily with his stock, as his standing amongst his fellow men is very much in direct proportion to the number of stock he owns. Furthermore, cattle are closely connected with certain native customs, *e.g.*, the "labola" payment (bride dowry) is in terms of cattle.

The native is gradually learning to sell his stock more readily, but the number he is likely to part with in this way in the future will be but a fraction of the normal increase.

(5) All grazing lands are communally owned by the tribes in possession of them; hence the individual is merely interested in these lands in so far as what he can obtain from them; *their ultimate fate is absolutely of no interest to him whatever.*

Overstocking.

In the Mwanza and Tabora Provinces, particularly, pasture problems have become very acute, due to a rapid increase in the stock numbers to beyond what the pastures can normally carry. The result is a deplorable condition of the stock during the dry season. In unfavourable seasons, a heavy mortality from starvation actually occurs, but of greater importance, the stock-carrying capacity of these areas is slowly but surely being seriously impaired; and, with the diminished vegetative cover, the all important fertility of the soil is being lost. The eventual outcome cannot but be disastrous to the native.

Possible means whereby this situation can be remedied, partly or wholly, briefly are:—

(I) Improvement in the Carrying Capacity.

Improved farming methods, thereby increasing the crop yields per acre, and incidentally the yield of crop residues, would only be of value in supplementing the fodder resources if adequate fuel supplies (other than maize and millet stalks which are at present used for this purpose) could be developed.

An effective increase, however, could be obtained by the establishment of superior pasture species. Enormous areas, too low in fertility, or too steep for annual cultivation, or of abandoned cultivated land, which at present slowly reverts to grass, could, by this means, be made to produce greatly increased quantities of fodder. With native communities, however, progress along these lines is necessarily slow, and undoubtedly will lag far behind the requirements of the increased stock numbers.

Still another means of bringing about a very appreciable improvement in the carrying capacity of fully stocked pastures is to practise a system of rotative grazing, whereby each season a portion of the pastures is allowed a period of recuperation. The voluntary adoption, however, of an animal husbandry practice of this standard can hardly be expected from pastoral native tribes owning their land communally, and unless some direct legislation is found to be feasible, progress through demonstration and teaching will be an extremely slow process.

(II) Provision of New Grazing Grounds.

In close proximity to the overstocked areas in the Territory, are vast pasture lands of excellent grazing quality which, at present, cannot be utilised owing to the presence of tsetse fly, or lack of permanent watering facilities.

The elimination of "fly" offers attractive possibilities in the provision of additional pasturage, and is at present under intensive investigation by the Department of Tsetse Research.

By bush clearing and other means, a number of square miles of valuable grazing actually have been freed of tsetse by this Department, and it seems only a question of funds being available

to develop almost unlimited new grazing, providing adequate water for the stock can be obtained. Where the expense of developing permanent supplies of water is prohibitive, these areas freed from tsetse could be used for grazing during the rainy season, when provision of water would be simple and well within the means of native stock owners. The practice of "trekking" to new pastures in the dry season after the home pastures have been exhausted is already customary in many of the overstocked areas, and there seems no real reason why this practice should not be reversed so as to obtain the maximum benefit. This system of grazing management is by no means new; in the western United States of America, many millions of cattle and sheep depart for distant high altitude pastures for the summer months, and return to the home pastures for the winter. To allow the overgrazed home pastures to recuperate, it will be essential to rest them during the growing season.

(III) Limitation in the Numbers of Stock.

A third, and possibly the only, permanent solution of the problem, is limiting the number of stock in each given area in accordance with its carrying capacity.

This will bring about a material increase in the carrying capacity of the overstocked areas, as overgrazed pastures produce only a portion of the fodder they are capable of producing if properly stocked, and at the same time serve as an effective means of reducing the grave loss of soil and soil fertility, which invariably follows closely at the heels of overstocking in arid or semi-arid areas.

To limit the numbers of stock allowed to graze in a given area, is an administrative problem set with many difficulties, but, with pastoral tribes owning their land communally, it seems essential if their future welfare is to be ensured. History has shown the necessity (as well as the benefits) of legislation for the protection of the vast public grazing lands of the United States of America, even when the only value placed upon the stock is purely monetary. If the development of new grazing lands for permanent occupation (as suggested in paragraph (II)) is found to be feasible, the enforcement of a sound grazing policy seems a first essential; otherwise the expenditure from the national viewpoint cannot be justified.

Problems in Other Areas.

Overstocking, although most pressing in the Provinces mentioned (Mwanza and Tabora), is unfortunately not confined to them, but is gradually becoming of increasing importance in other of the stock areas of the Territory, particularly in the semi-arid Central Province. Here the poor distribution of permanent water is chiefly responsible at present.

In most parts of this Province, browse plants afford a very appreciable part of the fodder resources, and consequently, pasture problems are somewhat different from those in the most purely grassland areas. Undoubtedly some of the browse plants afford very valuable feed, as is evidenced by the particularly excellent condition of the stock in such areas when the grazing (and water) conditions are at all adequate.

In the Iringa Province, most of which is high lying and well grassed, only a small portion of the pastures are at present fully stocked, though the reason for this paucity is not yet known. Mineral deficiency is suspected to be an important factor. Here the management and improvement of pastures in connection with settler farming are of importance, particularly in the Njombe grasslands, where sheep farming is contemplated. The customary practice of annually burning the pastures requires especial attention in this Province.

In the Northern Province, the wandering Masai tribes, with their large herds of cattle, are threatened by a shortage of grazing, owing to the encroachment of tsetse fly, and a paucity of stock watering places, which at present are totally inadequate in numbers as well as being badly distributed. Overgrazing is acute around the widely-spaced water supplies.

Feeding Value of Pastures.

In concluding this brief survey of the major pasture problems of the Territory, the determination of the nutritional standard of the various pasture types is considered to be of special importance. This information (which it is proposed to obtain by determining the seasonal composition of the more prevalent fodder plants, as well as by digestibility trials), is considered an essential foundation on which to base any possible scheme of grading up and improving the indigenous stock of the Territory, or the advisability or otherwise of introducing European or other improved breeds.

Investigation in Progress.

Herbarium: The first essential in the investigation of natural pastures is to be able to recognise the species of possible importance in all stages of growth. Work on the flora of the Central Province, with this end in view, has been in progress (by the Acting Director of Veterinary Services and Mrs. Hornby, in collaboration with the Botanist at the Amani Institute) for several seasons now, and a good representative herbarium has been compiled. Recently, some 300 species of grasses from various parts of the Territory have been added.

Fodder Plant Studies.

The Mpwapwa soils and climate are reasonably representative of a large part of the stock areas of the Central, Tabora and Mwanza Provinces, which contain the majority of the cattle of the Territory (in 1930: 3,233,207 out of 5,170,162) and is, in many ways, well situated as a central station for testing promising fodder plants for the Territory. Work on these lines is now well under way, and some 90 species or strains are already receiving consideration. Attention is not being confined to indigenous species, although these will probably be found to be the most suited to the trying climatic conditions. The aim is to make a detailed study of each species, including the growth habits, propagation,

composition at different stages of growth, and, of the more important species only, the digestibility. Grazing trials on acre paddocks to determine carrying capacity and ability to withstand grazing are also included in this programme of work.

Of the indigenous species under trial, the two most promising so far are: Star Grass (*Cynodon plectostachyus*), of which certain strains appear to be more valuable than others, and African Fox-tail (*Pennisetum ciliare*).

Fodder plants from South Africa, Southern Rhodesia, India, Australia and the United States of America have been introduced. Two species which show signs of considerable promise are: *Digitaria Poleevansii*, from South Africa and the Giant Panic Grass, from Australia.

Soil Erosion.

Particular attention is being paid to the important matter of soil erosion control, both by means of ground cover, and by testing live barriers planted on the contour. The reclamation for pasture purposes of badly eroded areas is also being studied. Such areas are of frequent occurrence in many parts of the Territory as the result of abandoned cultivated and overgrazed lands on hill slopes, and without some special attention, will remain more or less permanently of little or no productive capacity. Due to the stimulus in crop production, and through increased stock numbers, the area of these impaired lands is rapidly extending.

Plant Succession Studies.

A knowledge of the plant succession of each pasture type is necessary in determining its correct grazing management. This information will gradually be accumulated by means of observation surveys, the only method whereby appreciable headway can be made at a reasonable cost in a Territory of this size, and one yielding reliable results if carried out by experienced observers.

Grass Burning.

A scheme of pasture experimentation is seldom complete in any part of the continent of Africa without attention being paid to the effects of grass-burning on the pasturage. At the Departmental Stock Farm in the Njombe District of the Iringa Province, a comprehensive experiment has been laid down to determine the effects of fire on the grassland pasture, this being part of a very complete scheme of pasture investigation in connection with the possible use of this area for settler farming of woolled sheep.

Summary.

1. The investigation of the pastures of Tanganyika Territory has been commenced. Special attention is being paid to the study of important pasture plants and to pasture surveys, including the collection of data in connection with the correct management of pastures in stock areas.

2. Overstocking, due to the increase of cattle and encroachment of available grazing lands by tsetse fly, is rapidly producing a very serious condition in certain areas, not only through a heavy mortality of stock, but also by the destruction of the grazing, and by erosion of the soil.

3. Remedial measures are suggested; namely, by increasing the fodder resources, by reclamation, and by improved and organised grazing management.

4. Pasture reclamation must go hand-in-hand with water development, either permanent or seasonal (rainy season).

ENTOMOLOGICAL NOTE.

Entomological Researches in the Marquesas Islands, by *E. P. Mumford and A. M. Adamson.* (I. C. E., Paris, 1932.)

This report deals with a part of the activities of the Pacific Entomological Survey, the object of which is to record and to study the insect, or rather the Arthropod fauna of the Pacific Islands.

While the prime aim of the Survey is purely scientific, it is believed and hoped that the work will also have considerable economic value. The records of insect distribution will be of use in framing quarantine measures and, in addition, records of numerical abundance of pest insects in the various localities will very naturally aid in the searches for promising natural enemies to assist in the biological control of such insects.

It is particularly fortunate that such a Survey should have been possible at this time, for, as the authors point out, radical changes are taking place in the flora and fauna of the Pacific, of which the tragic decline of the Polynesian race and culture is only a special instance. These changes are particularly evident in the Marquesas Islands, which have thus formed a convenient starting place for the work of the Survey.

The authors show that as far as the insect fauna is concerned, there is a strikingly long list of endemic species on the one hand, and on the other, there is a striking absence of whole families and even certain orders of insects. While no general conclusion as to the existence of former land connections can be drawn at present, these facts suggest that the isolation of the Marquesas from other land masses is of very long duration.

Underlying the great changes which are occurring in the fauna and flora of the group, deforestation by grazing animals appears to be an important factor, which is altering the flora very distinctly and in consequence the whole of the insect fauna, dependent upon it. On most of the islands, however, this deforestation does not extend into the cloud belt, where most of the endemic species were found, but even in this region, important changes are taking place through the invasion of the primitive plant associations by the grass *Paspalum conjugatum* (sour grass) which has recently been introduced. There is also an active impoverishment of species brought about by the activities of an introduced predaceous ant.

The authors are to be congratulated both upon the attractive nature of the work they have undertaken and upon the vast amount of information which they have already been able to amass.

A. P.

THE FRUIT AND VEGETABLE INDUSTRY OF THE LEEWARD AND WINDWARD ISLANDS.

[*The following notes have been extracted from the Annual Report of the Marketing Officer, Mr. A. C. Shill, who is superintending the Fruit and Vegetable Trade of the Leeward and Windward Islands. Copies of the full Report which is shortly to be published can be obtained from the Advisory Department, Imperial College of Tropical Agriculture, Trinidad, B.W.I. These notes should be read in conjunction with Mr. Shill's Report on a Visit to Canada which was published this year.*]

Exports Statistics.

THE fruit and vegetable exports from the various islands which are, as far as possible, given in order of importance, may conveniently be summarised as follows:—

I. Green Limes.

	U. S. A.				Other Destinations.	
	1931. (Barrels)	1932. (*a*) (Barrels)	Season.	Peak of Season.	1931. (Barrels)	1932. (*a*) (Barrels)
Dominica	10,530	4,514	All Year	June-Sept.	351	300
St. Lucia	3,282	2,124	All Year	May-July	807	500
Montserrat	? (*b*)	140	—	—	? (*b*)	150
Antigua	20	28	—	—	—	—
St. Vincent	—	—	—	—	?	8
Totals	13,832	6,806	—	—	1,158	958

(*a*) To end of July.
(*b*) Montserrat's total green lime export in 1931 was 290 barrels which is, however, not comparatively indicative of Montserrat's total crop owing to juice contracts of long standing.

The 1932 crop is generally less than that in 1931, and the plantings in recent years, particularly those in Dominica following the losses from hurricanes, root disease and withertip, are not yet sufficiently advanced to give much return. A large proportion of the miscellaneous exports goes to Bermuda, particularly those from St. Lucia, and the balance is divided between Canada and the United Kingdom.

II. Tomatoes.

(EXPORTS IN 20 LB. CRATES.)

	1930-1931 approximately.	1931-1932.	Season (1931-1932).	Peak of Season (1931-1932).
Montserrat	17,000	19,614	Dec.-June	Feb.-March.
St. Vincent	1,300	8,843	Jan.-May	March.
St. Kitts	4,600	1,468	Jan.-March	February.
Nevis	1,300	1,416	Dec.-April	Jan.-February.
Antigua	400	852	Dec.-March	Feb.-March.
St. Lucia	—	74	Feb.-April	—
Dominica	—	23	Feb.-March	—
Totals	24,600	32,290	—	—

Almost all of the above exports are to Canada. Grenada shipped a few hundred crates.

III. Oranges and Grapefruit.

(EXPORTS ALMOST ENTIRELY IN FULL 2 FT. CITRUS CRATES).

	1931-1932. (crates.)	Season (1931-1932).	Peak of Season (1931-1932).
Oranges:			
Dominica	2,742	Sept.-March	December.
St. Lucia	299	Oct. -March	December.
Totals	3,041	—	—
Grapefruit:			
Dominica	2,015	Sept. -March	Nov.-December.
St. Lucia	83	Nov. -February	—
Grenada	(about) 300	—	—
Totals	2,398	—	—

The oranges and grapefruit are mostly sold in the Canadian Maritimes. Shipments to Bermuda average around 200 crates per month during the season. Dominica made one shipment of about 500 crates of both fruits to England.

IV. Mangoes.

	1931.	1932.	Season.	Peak of Season.
St. Lucia: Common and grafted ..	4,373	4,088	Mar.-Sept.	June-July.
Dominica: Common	975	838	Mar.-Sept.	June-July.
Grafted	292	227	Mar.-Sept.	June-July.
St. Vincent	—	79	May-Aug.	July.
Totals	5,640	5,232	—	—

The 1932 mango exports are given to the end of September, when the season is practically finished. With the Dominica exports the common mango figures are for full 2-foot citrus crates. The St. Lucia figures include grafted varieties packed in tomato crates and common mangoes in many half-citrus as well as in full-citrus crates. The difference between the exports from these two islands is not therefore as large as is apparently shown by the above figures. Almost all of the above fruit is sold in Bermuda. Small quantities of grafted mangoes are shipped to England and Canada.

V. Avocado Pears.*

(EXPORTS ALMOST WITHOUT EXCEPTION IN SINGLE LAYER CRATES OF $\frac{3}{4}$ FT. OR 1 FT. CAPACITY).

	1931.	1932 to end of September.	Season.	Peak of Season.
St. Lucia	2,718	3,362	June-Nov.	July-Sept.
Dominica	664	1,455	June-Nov.	July-Sept.
St. Vincent	500 (Approx.)	626	—	—
Totals	3,882	5,443	—	—

* Nevis and Montserrat also export small quantities of pears and mangoes to Bermuda.

With the exception of very small and usually unprofitable shipments to England and Canada the pears are almost all shipped to Bermuda.

VI. Miscellaneous Citrus and Other Fruits.

	Tangerines. (crates.)	Lemons. (crates.)		Lemon-Limes. (crates.)	Pineapples. (crates.)	Coconuts. (bags.)			
						1931.		1932.	
	1931-1932 Season.	1931.	1932.	1932.	1932.	Dry.	Green.	Dry.	Green.
Dominica	7	50	56	98	2	12	—	1	—
St. Lucia	118	—	—	—	205	?	—	?	—
Nevis	—	7	—	—	1	1	375	—	158
St. Vincent	—	—	—	—	2	?	—	7	—
Totals	125	57	56	98	210	13	375	8	158

All the 1932 figures given above are to the end of August. The "Lemon-Lime" is a cross between the Philippine lime and the West Indian lime and more closely resembles a lemon than a West Indian lime. With the exception of some of the St. Lucia pineapples which were sold in England most of the above fruit was disposed of in Bermuda, generally yielding much higher prices than could be obtained elsewhere. A few "Lemon-Limes", pineapples and coconuts were shipped to the Maritimes.

VII. Miscellaneous Vegetables.*

(1931-1932 SEASON.)

	Egg Plants. (Crates.)	String Beans. (Crates.)	Sweet Potatoes. (Crates.)	Carrots. (Crates.)	Okras. (Crates.)	Sweet Peppers. (Crates.)	Cucumbers. (Crates).
Dominica	34	179	24	—	46	1	9
Montserrat	—	211	155	189	—	—	6
St. Kitts	15	186	—	—	—	11	1
Nevis	28	47	16	—	—	8	—
Antigua	37	9	4	2	1	2	—
St. Vincent	241	11	—	—	—	—	4
St. Lucia	—	—	11	—	—	—	—
Totals	355	643	210	191	47	22	20

* During 1932 (to end of August) the following barrels of pumpkins were shipped—St. Vincent 18, Dominica 5. St. Vincent shipped 2 or 3 tons last autumn. St. Lucia ships a small unknown quantity. Almost all this export is to Bermuda.

Practically all of the exports tabulated above were sold in Canada (the Maritimes and Montreal).

VIII. Total Export Trade.

	Approximate Present Annual Export.	Estimated f.o.b. Value from Average Prices received.
Green limes	14,000 barrels	at 27/- — £18,900
Tomatoes	32,000 crates	at 2/9 — 4,400
Oranges	3,000 crates	at 10/6 — 1,575
Grapefruit	2,500 crates	at 9/- — 1,125
Mangoes	5,000 crates	at 6/- * — 1,500
Avocado pears	3,800 crates	at 4/6 — 855
Miscellaneous fruits	1,000 crates and bags	at 8/- — 400
Miscellaneous vegetables	1,500 crates	at 5/- — 375
Totals	62,800 packages	£29,130

* Value based on 7s. per full citrus crate.

Packing and Shipping Expenses.

The following are typical present average expenses for packing and shipping the principal fruits and vegetables exported :—

Limes.—(Dominica)—barrel 5*s.* 3*d.*; brown wrapping paper 9*d.*; packing, &c., 8*d.*; porterage and lighterage 5*d.*; duty 1*s.* (varies); wharfage 3*d.*;—total 8*s.* 4*d.*

Tomatoes.—(Montserrat Marketing Depot)—crate and label 8½*d.*; wrapping paper and liner 2*d.*; labour 3*d.*; truckage ¼*d.*; lighterage 1*d.*; inspection fee ½*d.*; cold storage ¼*d.*; miscellaneous (marking, &c.) ½*d.*;—total 1*s.* 4*d.*

IX. Oranges, Grapefruit, Mangoes and Avocado Pears.

(Dominica Marketing Depot).

	Oranges and Grapefruit. (2 cu. ft.)	Mangoes.		Avocado Pears. (¾ cu. ft.)
		Common. (2 cu. ft.)	Julie. (¾ cu. ft.)	
	s. d.	s. d.	s. d.	s. d.
Packages (*a*)	2 0	1 10	1 0½	1 0½
Paper (*b*)	6	6	3	½ (wood wool)
Labour (*c*)	5½	4	2	2
Inspection fee	1½	1½	1½	1½
Packing House fee	2	2	1	1
Duty	3	—	—	—
Wharfage	1½	1	½	½
Porterage	1	1	½	½
Lighterage	1½	1½	½	½
Totals	3 10	3 3	1 9½	1 7

(*a*) *Packages*—cost includes crate, building, nails, wire, labels. This cost will be reduced with new stocks.
(*b*) *Paper*—this cost will be reduced nearly 50 per cent. with new stocks.
(*c*) *Labour*—cost with oranges and grapefruit includes washing and grading, by hand or machine, wrapping, packing, heading up and stencilling. The cost with pears and mangoes includes washing (when necessary), grading, wrapping, packing, heading up and stencilling.
Cold Storage Charges—1*d.* per cu. ft. for 10 days, additional to above.

The foregoing expenses will serve to indicate also the general packing and shipping charges for other fruits and vegetables. Exports in bushel crates, such as carrots, sweet potatoes, egg-plants and okras bear charges of around 1*s.* 8*d.* With cucumbers, sweet peppers and string beans, the charges are similar to, or slightly less than, those for tomatoes when shipped in tomato crates. When miscellaneous citrus fruits are shipped in half-citrus crates the expenses are slightly more than half those for full-citrus crates.

Markets and Returns.

The natural markets for the produce of the Leeward and Windward Islands, at least under existing tariff conditions, are Canada and Bermuda. The American market is also favourably situated with ample shipping communication, although the cold storage space is limited and the freight rates are high, but either import duties or quarantines prohibit shipments except in the case of green limes. The present position, recently verified by the British Consul General in New York is as follows :—

Duties.

Limes	2 cents per lb.
Oranges	1 do.
Lemons	2½ do.
Avocado Pears ..	15 do.
Tomatoes	3 do.

Containers of foreign woods—25 per cent. *ad valorem.*

There is a quarantine against mango imports.

Some growers are contemplating shipping tomatoes to New York during the coming season but it is doubtful whether this market will prove more remunerative than Canada. The quality requirements are high and other sources of supply are more favourably situated and are subject to less import duty or none at all.

The general question of green lime marketing has already been discussed*. This question should be given due consideration by growers and exporters in these islands. Since the lime trade is well established and at present has no difficulty in disposing of the reduced crops, most attention has been given by the Marketing Officer during the past year to other exports.

Arrangements were made this summer for regular shipments of limes to Canada from Dominica; shipments have also been sent irregularly from Montserrat and St. Lucia. The principal package used has been the 20 lb. tomato crate ($\frac{3}{4}$ cubic foot) of which about 1,800 have gone forward. Mostly larger "medium" and "large" limes have been shipped, the 226 pack proving popular. The gross prices realised have ranged between $1.50 and $2.25, which are quite satisfactory for a new market, and there is every indication that a demand for this fruit, hitherto virtually unknown in Canada, is being established. Owing to lack of funds the only possible advertising is to keep the produce steadily on the market during the main season. Quotations from Canadian barrel manufacturers have also been obtained to verify the fact that the difference in price is not sufficient to offset the extra duty charged on barrels exported to New York of non-U.S.A. origin.

The English market is at present of very little value. The position can be summarised as follows:

1. Trans-shipment at Barbados is expensive and unsatisfactory and only two lines offer direct opportunities. One at present has no suitable temperature space available for tomatoes, it being required for bananas, and the citrus temperature space cannot be guaranteed owing to contracts with Puerto Rico. The cold storage accommodation of the other has recently been extended but is still limited for different temperature ranges. Further, with little other freight it would often be difficult to get enough cargo to induce a call.

2. The transit time is longer and hence the condition on arrival of fruits and vegetables, particularly the latter, would be inferior.

3. The English tariff advantages are negligible and do not compare with those in favour of these islands in Canada, the freight is higher (about 25 per cent.), and there is, under present conditions the question of exchange on returns in favour of Canadian shipments.

At the present time shipments to England are limited to an occasional shipment of oranges and grapefruit and, as opportunity offers, small shipments of limes, grafted mangoes and pears. Advice regarding suitable brokers has been circulated.

To return to a brief consideration of the principal markets, Canada and Bermuda. The efforts to increase the green lime market, referred to above, should, in view of the increasing crop, be given every support by growers and exporters; in this connection efforts should first be concentrated on Montreal and Toronto where possibilities seem to be better than in the Maritimes where the lime is almost unknown and does not seem to be wanted by the "trade".

The present quantities of oranges and grapefruit in excess of the Bermuda market requirements hardly call for shipments inland from the Maritimes; when sold in the Maritimes no rail freight charges are involved and American shipments are at a disadvantage with higher rail charges, whereas the situation is somewhat reversed with inland shipments. Correspondence is in progress indicating the probability of extending satisfactory sales to Newfoundland.

With regard to the general prospects for avocado pears and mangoes, the mango has better possibilities than the avocado and small shipments of the former during this summer have yielded fairly satisfactory returns, averaging around three cents net per fruit, whereas shipments of the latter fruit have almost without exception showed a loss. The apparently unsurmountable obstacle to building up any appreciable trade in these fruits, particularly with pears, is the rapid ripening after the comparatively long time in transit in cold storage; this means that the fruit is a total loss unless it is distributed and sold within a few days, and no trade of much value can be built up on this basis. The difficulty cannot be overcome by sending more immature fruit as then neither mangoes nor pears would ripen satisfactorily on arrival. With pears, the express rail-transit time (36 hours or so) is often sufficient to make them over-ripe on arrival in Montreal. Direct shipment opportunities to Montreal are rare and rail refrigeration requires a minimum of 10,000 lb. even on L.C.L.*

The Canadian market for tomatoes and miscellaneous vegetables has already been discussed in detail†. Points particularly considered were the agencies (brokers and jobbers), methods of marketing, and individual marketing requirements for the various fruits and vegetables. The arrangements made last season by which almost all the products shipped to Canada from these islands were sent to one broker only, in St. John, Halifax, and Montreal, was a decided step in the right direction.

The Bermuda market is of great value to these islands as shown by the foregoing statistics but increase in exports to this destination can hardly be expected, except perhaps with oranges and grapefruit. With present shipments of pears and mangoes the market is saturated at the peaks of seasons. Bermuda is amply supplied with limes, particularly from St. Lucia, and being a vegetable growing island the market will only take small quantities out of season. The returns are generally good and exporters who in the past have only shipped to Bermuda are apt to have a wrong sense of values, with, for example, gross sales of often inferior oranges, lemons and grapefruit at around £1 per case and pumpkins at £1 per 100 lb.

* *See* Report on Visit to Canada, Section V (3).

* Less than Car Lot.

† *See* Report on Visit to Canada.

Obviously there is little to be achieved by attempting to alter the present Bermuda marketing methods. It is a small market without the usual trade channels of distribution and shipments are now generally made direct to retailers or wholesale-retailers. A limited quantity is sold by one or two commission merchants. Any attempt to ship all the produce of these islands to one agent would almost certainly, under the particular market condition, result in reduced distribution and sales.

The only trade in fruits and vegetables not yet referred to is the inter-island trade. The majority of this is carried on by hucksters, one of the biggest trades being between St. Lucia and Barbados, and the size and value of these exports are difficult to estimate. Montserrat shipped inter-islands about 1,000 bushel crates of onions last season, mostly to Barbados, this export not being included in the foregoing statistics. These netted an average of about four cents per lb. to the growers. Dominica also disposes in this manner of many cull oranges and grapefruit.

In the statistical section the average returns are indicated for the principal exports in the f.o.b. values and the packing and shipping expenses, the differences giving the returns to the producer. Since each of the principal products is exported almost entirely to one destination, the United States, Canada, or Bermuda, the situation is not complicated by comparative market returns. The average gross prices realised where sold are obtained by adding the cost of freight at 25 cents or 35 cents per cubic foot for ordinary and cold storage respectively, and an average agent's commission and charge for handling, &c. With barrelled green limes to New York the freight is 85 cents (American) per barrel and there is also the American duty, but practically all sales are made f.o.b.

The lime, orange, grapefruit, mango and avocado pear prices call for no particular comment and shipments are virtually confined to Dominica and St. Lucia. Tomato growing is, however, more general and details of packing costs, average net returns and market price variation for last season are given below for various islands for comparison.

X. Tomato Shipping Expenses and Returns.

Island.	Packing and Shipping Expense per crate f.o.b.	Net Return to Grower per lb.	Remarks.
Montserrat..	32 cents ..	1.2 cents ..	Actual average return 0.9 cents, but profits from packing house charges, 2nd. decimal per lb. shipment dividends and inspection fees offset the loss on advances so that the return was actually 1.2 cents as advanced. No overhead charges.
St. Vincent..	32 cents ..	1.1 cents ..	Not including any Bureau commission for overhead. This price is after deducting local bus and boat transport charges from two outside packing sheds. No similar charges occur in Montserrat.
St. Kitts ..	37 cents ..	0.5 cents ..	f.o.b. charge excludes 4 cents packing house charge. The higher expenses are due mainly to the expensive old stock of paper and higher labour charges with a smaller crop.
Nevis ..	42 cents ..	1.1 cents ..	Ditto.
Antigua ..	38 cents ..	1.4 cents ..	Includes rent of packing house, about 6 cents per crate, but no other overhead. The Department Staff, however, did a fair amount of the packing, hence reducing labour costs.

The general market trend is indicated by the monthly range of average gross amounts realised (in Canadian currency) per crate for shipments from the Montserrat Depot and the St. Vincent Bureau.

XI. Average Tomato Prices.

Tomatoes sold in	St. John.		Halifax.		Montreal.	
	Montserrat.	St. Vincent.	Montserrat.	St. Vincent.	Montserrat.	St. Vincent.
December	2.75	—	—	—	—	—
January	1.10-1.30	1.10-1.30	—	—	—	—
February	0.75-1.00	0.75-1.06	0.94	0.70	0.65	—
March	0.65-0.90	0.90	1.05-1.15	0.75	1.00-1.19	1.00
April	0.75-0.80	0.80	*0.10-1.17	1.09	0.43	0.75
May	0.95	0.95-1.00	0.81-0.87	1.19	—	0.65
June	0.85	—	—	0.55	—	—
Total Shipments (crates)	4,686	1,353	2,493	879	3,828	1,210

* Toronto sale during glut.

The balance of the Montserrat crop was grown and shipped by one planter who sold at three cents (Canadian) per lb. f.o.b., advance, *i.e.*, 60 cents per crate. This fruit was sold in the Maritimes and Montreal by a different agent. The balance of the St. Vincent crop was shipped privately and almost entirely to the Government's brokers, similar prices being received. Antigua's crop was sold in the Maritimes, and the St. Kitts-Nevis crop was, under an arrangement made prior to the general marketing arrangement for the season all consigned to the Government broker in Montreal and sold there and in the Maritimes.

A few average returns, net to the grower, on other crops are given for comparison :—

XII. Average Net Returns for Vegetables.

Crop.	Montserrat.	St. Kitts.	Nevis.	Dominica.	Antigua.
Carrots per bushel	82 cents	—	—	—	—
Sweet Potatoes per bushel ..	45 cents	—	—	80 cents	51 cents
String Beans per lb.	3 cents	—0.3 cents	0.5 cents	2 cents	2.2 cents
Cucumbers per crate	$1.64 (Tomato crate)	—	—	$3.60 (bushel)	—
Sweet Peppers per lb.	—	6 cents	6 cents	—	—
Egg-Plants per lb.	—	0.8 cents	1.4 cents	4 cents	1.5 cents

General Crop Possibilities.

There are two principal factors which are retarding the progress of the export trade at the present time, firstly the small quantities of produce available and secondly the lack of finance amongst most producers or potential producers. The second factor governs the first to a large degree, particularly with fruits; with annual crops its effect is not so considerable.

Fresh Limes.—The output is now relatively small but recent plantings in Dominica, St. Lucia and Montserrat have been extensive. The possible limitations of the U.S.A. market have already been referred to*, and details are given elsewhere in this article of the steps taken to open up the Canadian market. The fresh lime trade, with the additional lime-oil outlet, should continue to prove remunerative despite increasing exports.

Oranges and Grapefruit.—Plantings so far have been very limited. There is every indication that there would be no difficulty in very satisfactorily marketing a much larger orange export. Two factors enter largely into planting, firstly, the need for a location with suitable transport facilities, a very considerable feature in these islands from the standpoints of expense and damage to fruit, and secondly, it seems very probable that a certain altitude, around 1,000 feet, is necessary to obtain some natural colouring since the artificial colouring needed with full green fruit is excessive. Since the grapefruit crop coincides with main crops of other regions and is obtained when it is winter in Canada the marketing prospects are not as good as with oranges, but with the low costs of production in these islands, provided that the location is favourably situated for transport, there should be no difficulty in competing successfully. These crops are apparently climatically limited to Dominica, St. Lucia and Grenada. Local experience in St. Vincent has not been favourable.

Mangoes.—Difficulty has been experienced in Dominica in obtaining at one time in the middle of the season eight hundred fruits of grafted varieties for export and it is thus seen that to all intents and purposes the present crop is of seedlings. A fair amount of top working of seedlings and distribution of budded and grafted plants has recently been carried out and these efforts should be pushed forward. Even if the trade is now virtually limited to the Bermuda market and shows little immediate possibilities of extension all exports should be of grafted fruit. Further, if a Canadian trade is to be built up, supplies of fruit of grafted varieties must be available. Since Dominica and St. Lucia control the present trade and there seems to be little prospect of appreciable market extension in the near future, any considerable increase in production in Montserrat, St. Vincent and Grenada, the other islands climatically suitable, does not seem to be warranted.

Avocado Pears.—This crop is about the only major fruit or vegetable crop in the islands the supply of which exceeds the demand during the season. The majority of the export is of fruit of seedling trees of very fair average quality. Selection of local seedlings and of imported varieties for propagation is, however, in progress to improve the general quality of export fruit. Apart from this work no considerable extension of this crop can be recommended in view of the marketing situation. The bulk of the trade is

* *See* Report on Visit to Canada.

in the hands of St. Lucia and Dominica with smaller exports from St. Vincent and Montserrat. Apparently the pear crop in Grenada is later than in St. Lucia and Dominica, pears in fair quantity being available in the New Year; it would seem that an export trade from Grenada to Bermuda could be built up at this time of the year, and the necessary steps are being taken to fill this market.

Tomatoes.—The relative limitations of the Canadian market have been referred to already*. The quantities exported by these islands are, however, relatively small compared with other Canadian imports and if the production costs and fruit quality permit successful competition the export can be increased. Montserrat is most favourably situated as regards climate and general production costs. It is a suitable crop for the peasants in Nevis and Antigua. The St. Kitts climate is suitable but the crop is hardly suited to large estates except possibly as a catch crop on cane banks and even then the labour costs and the need for more personal supervision arise. It seems that the rainfall in Dominica and St. Lucia is too high and transport to packing sheds is relatively difficult. Grenada would appear to be similarly situated and large plantings should not be made pending further investigation; further, since Grenada has not yet tried the crop commercially, it would seem to be as well to leave the working up of a market for the next year or so to the islands already involved. It has yet to be seen whether the St. Vincent climate is suitable for satisfactory yields and relative freedom from disease; the crop there, as elsewhere, would appear to be primarily suited to peasant cultivation.

Other fruits.—Not much extension of the cultivation of other fruits can be recommended. More tangerines up to a reasonably small export could undoubtedly be marketed satisfactorily. The lemon export to Bermuda, which now proves very remunerative, could be increased but the crop must remain small since it seems that the fruit produced is unlikely to compete successfully as regards quality on the Canadian market. The cultivation of Philippine lime hybrids and Woglum limes is not recommended; they can only be sold as inferior lemon substitutes and it would be better to grow lemons. The coconut market is very limited. A pineapple export could only be handled on a large scale to give competitive production costs and even then successful competition is doubtful; a trial on the Canadian market with fruit, say, from St. Kitts or Antigua, would be of value.

General vegetable crops.—Onions seem to be the only vegetable crop which can be considerably extended in these islands.† The exports of this crop have diminished considerably in recent years. It has been an established industry in Montserrat for a long time, the annual export from 1921 to 1929 being usually valued around £1,000 to £2,000. The maximum export was in 1927 when some 9,000 bushels were shipped with a value of £6,663. Antigua's export was even larger, the peak period being from 1913 to 1917 when nearly 7,000 crates were shipped annually. The Nevis exports were on a much smaller scale. As shown by Montserrat's inter-islands sales last winter the local demand is considerable and exports to Canada can be extended. This crop possibility is connected principally with the northern Leeward Islands, the Grenadines, and perhaps parts of Grenada. Egg-plant sales are generally remunerative but no appreciable increased production is warranted. There is very little possibility of increasing the market for okras. It seems that the small exports of sweet peppers and cucumbers could be increased to a limited extent. Owing to heavy rail charges the export of selected local sweet potatoes and pumpkins is practically limited to the Maritimes and Bermuda, and in Bermuda a prohibitive duty prevents imports of sweet potatoes; the exports of these crops can, however, be increased to a relatively limited extent. The above mentioned crops are not limited to any particular island. The export of carrots is remunerative and can be increased; the soil, rainfall and altitude requirements, however, would seem to limit this crop to certain higher parts of Montserrat and St. Kitts. Pending further disease control experience the export of string beans is not recommended.

* *See* Report on Visit to Canada, Section V (1) (*a*).

† *See* Report on Visit to Canada, Section V (3).

Pooling of Produce.

The St. Lucia Fruit Conference of 1930 recommended that there should be no interference with individual freedom in the marketing of fruit and vegetables after these are prepared for shipment. This policy has been adhered to. In practice the majority of the produce is marketed through the Government Depots since the growers realise that the marketing is carried out to the best possible advantage; this applies particularly to Canadian shipments; with the Bermuda market the growers fully avail themselves of shipment orders obtained from the different Depots' agents.

The general marketing policy throughout the past year has thus been very uniform compared with the previous years and the policy of shipping from all the islands to Canada to one agent in each city has been generally adhered to. In addition to the pooling of shipments in this manner it has been the custom to pool all the tomatoes received for shipment, the grower just being credited with his weight of fruit included in the shipment. Owing to very variable quality this produce pooling is not generally possible with other fruits and vegetables, produce of different growers being kept separate.

Fruit and Vegetables of Small Producers.

The St. Lucia Conference recommended that fruit and vegetables suitable for export offered by small producers should be received and marketed on their behalf. This recommendation has been carried out. The Conference further

recommended that, where possible, it is desirable that a first or part payment should be made for such produce. It was arranged during the last vegetable season for the Governments in the islands concerned to advance two cents per lb. of tomatoes accepted from peasants for shipment. This advance was reduced in Montserrat in the middle of the season to one cent. With this advance on the major crop no advances were necessary for minor exports. Admittedly, with the exception of Montserrat, this involved the Government in small losses but these are not considerable in view of the need for fostering the industry in its early stages. Further, the export provided considerable employment for labour for growing and handling the crop; without the crop it would almost certainly have been necessary to provide relief work. Generally, since, with produce accepted and marketed by the Government, no charge is made for packing and shipping expenses until receipt of account sales, a considerable advance is virtually made on all such produce.

Since there is every probability that the market will be no worse and little better than last season it is expected to advance one cent per lb. (accepted for shipment) during the coming tomato crop.

The Canning Industry.

As requested by the St. Lucia Conference the possibility of establishing a central cannery has been thoroughly explored, and also the canning and by-product question in general. From cost quotations obtained from various sources and from observations of local conditions there does not seem to be any possibility of canning being an economic proposition in these islands, at least for some time to come. A central cannery is out of the question since the land and sea transport and package costs of the raw products from other islands would alone amount to more than could possibly be paid for them at the cannery. It also does not seem that a cannery could operate successfully using the products of any one island for the following principal reasons:—

(*a*) Insufficiency of supply of raw products to justify overhead expenditure. Further, in no island is there a range of suitable fruits for canning which would enable the cannery to operate for the majority of the year. No commercial cannery operates successfully on one short season crop.

(*b*) The relatively expensive transport to the cannery within any one island, and higher can costs owing to ocean freight and reforming machinery would make competition difficult.

The tomato trade, for example, is essentially that of export of out-of-season fresh fruit. Green culls are the only supplies available for canning, apart from rejects ripened on the plants which is not a desirable practice, and these after ripening would only produce the lowest grade product which could not possibly compete with, say, Canadian products. In Canada about three quarters of the total crop is used for canning and hundreds of acres are specially grown near the canneries.

The grapefruit production available for canning is negligible and competitive pineapple canning is out of the question. The Puerto Rico Department of Agriculture also reported that with the exception of grapefruit and pineapples they have had no success with the canning of other tropical fruits.

It would seem that with the inevitably higher costs the only hope for canning in these islands is to market a new product, for example, using guavas, but the finance needed for the necessary advertising, &c., and the difficulty of marketing a new product in times of depression render such an undertaking unadvisable. This also applies to other by-products, bottled or candied, such as guava jelly or cheese.

The possibilities of fruit juices and other products are discussed elsewhere.* The development of an export of burred juice (lime, grapefruit and orange), seems to be the most promising by-product possibility. Samples of burred lime juice (with added preservative) were manufactured by two methods and forwarded to Canada last summer but reports on them are not yet to hand. This possibility will be further investigated during the coming grapefruit and orange season.

* *See* Report on Visit to Canada, Section VI.

PLANT IMMUNITY.

A very interesting point of view has stimulated the investigations of Dr. A. C. Leeman into plant immunity (*Tent Bacteriologie*, Abt. II, Bd. 85). It is recognised that anti-body production and related phenomena, as they are associated with the animal body, play no direct part in the immunity of a plant. But it is shown that certain extracts and organic substances play a considerable part in stimulating the resistance of a plant to attack by a fungus disease. The substances when added to the soil, are harmless to the parasite, but become detrimental when taken into a plant and incorporated with its protoplasm. Secretions and extracts of micro-organisms, and various enzymes, have been found to reduce the damage caused by the parasitic fungus *Helminthosporium Sativum*. The interaction of micro-organisms has also been studied as a means of disease control.—(*Nature*, No. 3268, Vol. 129.)

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STUDIES IN TROPICAL LAND TENURE.

By H. Martin Leake, sc.d.

(4) East Africa.—*Contd.*

Uganda.

The evolution of the present land system in the Uganda Protectorate has proceeded on lines materially different from those described for Kenya. Partly this is due to the fact that the first contact with Uganda is an association with one of the most advanced and highly organized of the indigenous races, the Baganda; partly the reasons are to be found in history. The first steps towards occupation were taken unwillingly and with a force too small to dominate the situation. There is no question of conquest and imposition of an alien system; penetration proceeded by treaty. The first permanent penetration of the country was made by Arabs about 1800 and resulted in a partial supercession of paganism by Mohammedanism. Christianity was first introduced by Stanley and, at his instigation, a party of Protestant missionaries proceeded to Uganda in 1877. They were followed in 1879 by a party of French missionaries and soon a divergence of interests arose between the three religious interests. The importance of this missionary effort lies in the fact that the Chiefs, who, under the indigenous system, dominated the country, in many cases became converts to one or other of the three religious parties with the result that in this early period, politics and religion, working on a weak Kabaka (King), became inextricably interwined.

Administrative interference in Uganda arose from other causes. It has already been noted that the International Agreement of 1886 did not carry the definition of the boundaries of the spheres of influence to include the hinterland and thus left an opening for Peters to attempt to gain Uganda for Germany; a matter only settled by the Agreement of 1890 which placed Uganda within the British sphere. The force of circumstances had compelled the Imperial British East African Company to intervene and, in 1888, Jackson was despatched to Uganda and was able to obtain the acceptance of a flag by the Kabaka. In 1890, with the authority given by the Agreement of that year, Lugard was despatched to settle the internal affairs of the country. In March, 1892, Lugard completed a treaty with the Kabaka, Mwanga, by which the suzerainty of the Company was recognized and a Resident accepted without whose consent the Kabaka agreed "to make no treaties with, grant no kinds of concessions to, nor allow to settle in my Kingdom and acquire lands or hold Offices of State, any Europeans of whatever nationality" (1).

Thus early is a policy of dominance of the indigenous interests in land laid down; a policy in marked contrast to that adopted in Kenya. Lugard also entered into agreements with the Chiefs of Toro, Ankole and Kavallis. Later in the same year, in view of the announced intention of the Company to withdraw from Uganda, the British Government deputed Portal to visit the country and, as the result of his visit, a further agreement was ratified and Uganda proclaimed a British Protectorate on the 27th August, 1894 (2). Agreements were also entered into with the Chiefs of Toro, Ankole, Kavallis, Kaswa and the Sheikh of Wadelai.

So far all administrative action had been of a provisional nature, the main effort being directed to a pacification of the country. In 1899 the serious business of building up a permanent administration was undertaken and, for this purpose, Johnston was despatched at the head of a special commission. Johnston arrived in 1899 and, in 1900, completed the Uganda Agreement with the Kabaka and Chiefs of Baganda while similar agreements were concluded with Toro (1900) and Ankole (1901). This Agreement, which defined in great detail the major rights in land, owes this character in large measure to the need for a conjoint settlement of the religious question. In the other agreements the rights of the Chiefs in land are not given in the same detail.

The Uganda Agreement, which concerns merely what is now known as the Buganda Province and forms the most important section of the Protectorate, grants to the Kabaka direct rule over the native, administering through the Lukiko (Council), and divides the country into twenty districts or administrative counties (Saza) each under a head chief (Owesaza). Provision for the allotment of land is laid down on the basis of an assumed area of 19,000 sq. miles. Allotments are defined as follows, while certain provisos are given for adjustment in the event of the estimate proving erroneous.

Forests	1,500	sq. miles.
Waste, vested in His Majesty ..	9,000	do.
Plantations and Private Property of the Kabaka	350	do.
Plantations and Private Property of the Namasole (Queen Mother) 6 being personal and 10 impersonal	16	do.
Plantations and Private Property of Namasole (Mother of Mwanga)	10	do.
Princes (by name) 8 sq. miles each	32	do.
Princesses	90	do.
Abamasaza		
Private Property 8 sq. miles ea.	160	do.
Attached to Post 8 sq miles ea.	160	do.
Three Regents		
Private Property 16 sq. miles ea.	48	do.
Attached to Post 16 sq miles ea.	48	do.
(The latter to pass to the three Native Ministers on termination of the Regency.)		
Carried forward ..	11,414	approx.

Brought forward	11,414	sq. miles.
Two Chiefs (by name)	44	do.
1,000 Chiefs confirmed in present estates computed at	8,000	do.
Three Missionary Societies ..	92	do.
Land already taken up by Government for Stations	50	do.
	19,000	approx.

Beyond the definition of boundaries the Agreement touches only one point limiting ownership. Minerals on private estates are declared the property of the owner but subject to an *ad valorem* duty of ten per cent. while, outside these estates, they are the property of the administration. Rights in forests are left to be defined in a further treaty which was duly made in 1907.

There is here a very definite bias towards development along indigenous lines, for only 9,000 out of some 19,000 sq. miles are reserved for alienation and this, undoubtedly not the most desirable of the land from the agricultural aspect, has a potential value for colonization by aliens. Further, the principle of large landed estates in personal possession of the leaders of the native population is confirmed. Here a marked contrast is offered to the development of Kenya and, as a result, it is the native and not the colonist's interest in land which dominates the Uganda picture. It is this aspect that will here be considered first; and it may be noted that the limitations to the transfer of land to non-natives which were incorporated in the Lugard Agreement of 1892, were further emphasised by the Land Transfer Ordinance (Ordinance III of 1906) which specifically lays down that no land of a native or right in such land is to be transferred to a non-native either *inter vivos* or by will *in perpetuo* or for a term of years without the Governor's consent and that the Governor need give no reasons for a refusal. In practice, land so conveyed is first transferred to Government.

The first step towards the practical determination of the land question consisted in the demarcation of the rights granted in the various treaties. This demanded a survey and immediate steps were taken to institute a Survey Department. But the question was not capable of immediate or ready settlement, especially in the Buganda Province to which the Uganda Agreement applied. This was partly due to the time necessarily required to complete the survey but partly also to the difficulty which arose in determining what areas, with their respective claimants, were the subject of claims. To tide over the intermediate period of doubt the Buganda Land Law was passed in 1909. This Law permitted the issue of provisional certificates and a further Law was passed in the same year, under which failure to lodge an application for a provisional certificate before the end of the year involved relinquishment of any claim. In 1912 a general Crown Lands (Ascertainment) Ordinance (Ord. 21 of 1912) was passed under which all land not held under a Government certificate of ownership or in virtue of a claim sustained on the ground of continuous occupation or cultivation for a specified period of years, was deemed to be Crown Land. By 1913 doubts had begun to arise as to titles and in that year an Agreement, Baganda Agreement (Allotment and Survey) of 1913, was entered into to remove these doubts as to the validity of the allotments under the Uganda Agreement, and for the adjustment of discrepancies in areas disclosed by the survey. As the survey proceeded, questions as to the exact rights conferred on holders had arisen and these had been defined in the Buganda Land Law of 1908. The more important features of this comprehensive Law are as follows :—

(1) The Law starts by defining as 'mailo' any land whether surveyed or not, which is finally recognized by Government as held by secure title. Hence the certificate finally issued is known in future as the 'mailo certificate'.

(2) The consent of the Governor and Lukiko is required to hold more than 30 square miles except the additional area comes by inheritance.

(3) Power is given to alienate to another of the Protectorate by will, sale, or gift, &c., but power to hand over to other than one of the Protectorate or to a Church requires the consent of the Governor and Lukiko.

(4) Power to lease for more than one year to other than one of the Protectorate requires the consent of the Governor and Lukiko.

(5) Power to will is limited only to such as are alive or conceived at time of death while the rules of succession of the Baganda apply in cases of intestacy.

(6) Mailo ownership does not include roads or waters or the right to check grazing until the land is fenced.

(7) There is no compulsion to give to a superior chief any produce in money or kind.

(8) In the case of intestacy with no heir the land passes to the Governor and Lukiko as trustee for the Baganda.

In the case of official mailo, the holder of the office is entitled to all profits of the land and, on relinquishing the office, to such compensation for improvements as may be decided by the Lukiko. Finally, rules are laid down for the disposal of excess mailo.

Still further to clarify the question of title an Ordinance was passed in 1922 (Ord. 22 of 1922) which defined the organization for the Registration of Titles and under which the Torrens system of registration was adopted (3). Final mailo certificates were issued by the Registrar and provision was also made for the registration of leases, sub-leases and mortgages.

So far the question of the title to, and rights in, land as conferred to the original holders under the Uganda Agreement has been considered. But the tenure system is not so simple. Under the native system the Kabaka still maintained the right to confer titles under what is known as the Butaka system and this system has for

long constituted a very vexed problem. The source of this Butaka system of tenure can be traced to early times, probably to a time before the events which introduced the present ruling class to the country, and is intimately bound up with the clan system which involved a worship of ancestors. The early clans based a claim to a heritable right to land on which their ancestors were buried and thus established a personal estate (Butaka) heritable by the clan which elected the successor to the property. Sales, as such, were unknown though gifts of small areas to the sons were permitted and recognized after death of the donor. With the arrival of the present rulers, the original Butaka (owners) were left in possession but their right was of the nature of a gift from the Kabaka who claimed ownership to all the land. He further exercised his right to overlordship by granting Butaka rights either to unclaimed lands or to land carved out of earlier estates. In this matter of resumption the custom appears to have been complex. On the death of a Mutaka (owner of a Butaka) who was the original grantee, the Kabaka reserved the right to resume most of the estate leaving a small area only round the actual burial ground; but, with each succeeding generation, the area liable to resumption would be less and less. Thus the hereditary right had a validity which increased with time. Further, it gradually became customary for a Mutaka to nominate his successor, usually his son, and his choice was commonly accepted; thus the Butaka lands became regarded as personal estates directly heritable by descent.

The system, like so many indigenous systems, and like that of the Kikuyu, is obviously in process of evolution. Through the play of internal forces and under the circumstances, the actual rights of the Butaka holders were difficult to determine. The subject of Butaka tenure had for long been for the Administration a thorny question which came to a head about 1924. The difficulty involved concerned less the system of registration than the determination of the right to register and, consequently, little information concerning the intricacies of the problem are on record. The above brief outline is drawn from an unpublished discussion of the subject by Carter (4).

The preceding discussion is concerned only with the ownership of land. Generally speaking, the estates laid down by the Uganda Agreement are large and are, in practice, regarded as a source of revenue to the owner. There remains the question of the position of the actual cultivators of the soil, the Bakopi. Under the original Butaka system, the Mukopi (singular of Bakopi) occupied the position of tenant at will of the owner; he could be evicted at pleasure and his tenure was, thus, very insecure. If, in practice, it happened that the son very frequently carried on the holding of his father and a certain hereditary right appeared to exist, the custom arose merely from the desire of the owner to keep a large tenantry and so increase the value of his estates. No rights were admitted. This is the natural position when population has not exerted a pressure on the land and competition is rather for tenantry than for land. The right to cultivate as a Mukopi is, too, acquired on no very onerous terms, mainly consisting of certain duties of service. But with the coming of more settled conditions, a change will take place, and is already taking place, for, in 1930, it is noted that the "system of land-holding introduced under the Uganda Agreement, besides being entirely foreign to pre-existing native ideas, is productive of numerous abuses, since landholders tend to degenerate into mere rent farmers" (5). Pressure on the land is becoming such that rackrenting has become a possibility of which account must be taken. Steps had, as a matter of fact, already been taken to limit and stabilize the demands of an owner from his Bakopi for in 1927, was passed the Buganda Busulu and Envujo Law. This Law laid down that :—

(1) Every resident on land of a mailo owner who is liable to poll tax (the poll tax had been substituted for the hut tax in 1910) shall be liable for busulu at the rate of ten shillings per annum whether he is actually a holder of a kibanja or not, provided no mukopi shall be refused the privilege of working for a period of one month in lieu thereof;

(2) Payment of busulu gives the mukopi the right to cultivate as he wishes all food and other produce excluding scheduled crops and subject to the payment of envujo (a payment in kind defined in some detail as one gourd mwenge (beer) at each brewing and one barkcloth tree in every five up to a limit of two and none if the number of trees is under five);

(3) For cotton, coffee and other scheduled crops the mukopi pays a further sum, varying with the situation of the Saza, for areas of one to three acres as set out in the schedule and for areas above three acres by mutual agreement;

(4) The mukopi has no power to sub-let;

(5) The mukopi has the same right of access to pasturage, &c. as is permitted to the Baganda on Crown Lands under the Forest Agreement and without further payment;

(6) No mukopi may be evicted except for public purpose or for other good and sufficient reason unless the court make an order;

(7) A mukopi renders all respect and obedience to the mailo owner as prescribed by native law and takes good care of the land and buildings;

(8) With the chief's consent, the mailo owner can give to another a kibanja left derelict for six months;

(9) On eviction a claim to compensation be considered by a court.

In 1928 a further Law, the Buganda Land Tax Law, was passed. This Law endeavours to adjust the contribution of the native land owner towards native administration in proportion to his wealth. The chief features of this Law are that:—

(1) Every native of Buganda owning more than ten acres shall pay a tax of 15s. to 25s. according to the situation of the land; but all with less than five tenants shall pay 5s.;
(2) Every person paying rent to a native land owner in respect of residence or occupation of land shall pay 1s.;
(3) The tax paid under (2) may be deducted from the rent.

In these Laws are to be traced in embryonic form that system of tenancy control and a land revenue system based on equality of land which has been seen to have been evolved to such a high degree of complexity in India; the stimulus in the two cases is fundamentally the same.

The further development of the tenure system as it affects the native is of a more general nature. Under the Uganda Agreement some 9,000 square miles were reserved as vested in His Majesty to become Crown Lands. But, before that date, a series of Land Regulations (Reg. 4 of 1897) had been laid down which empowered the Governor to grant certificates for a term not exceeding 21 years and land lawfully held by anyone prior to the passing of the Regulations could claim a certificate. The certificate was to be registered and a fresh certificate might be granted for a further period of 21 years. A Crown Lands Ordinance (Ord. 2 of 1903) was passed in 1903. Under it the Governor is empowered to sell or lease Crown Lands, freeholds being granted up to a maximum of 1,000 acres or in excess with the sanction of the Secretary of State, a preliminary lease for three years being taken during which specified development must be undertaken. Leases are granted up to a maximum of 99 years at rentals varying with the length of the lease and are arranged by private treaty. Leases issued to other than Europeans and Americans are for one year and subject to three months notice, limited to five acres and granted by the Commissioner. In these Laws no other restriction is placed on nationality. Alienation in freehold was discontinued in 1916 (6).

In the Crown Lands and in the Butaka lands, once the question had been settled, lay a source of available land and the recent tendency has been to meet the impetus towards rackrenting which has already been noted, by the acquisition of freeholds. "As the result of settlement of the Butaka question in Buganda, great activity in respect of transfer of land has been displayed by natives whose great aim is to acquire small holdings and thus free themselves from the exactions of the landlords" (7). And again, in the report for 1930, "Considerable activity continues to be displayed in respect of transfers between natives of small holdings which are being carved out of large estates." Development is, thus, in the direction of a peasantry occupying small freeholds.

Uganda has, thus, remained essentially a field for native production, for the estates in alien occupation and run on a plantation basis represent only a small percentage of the cultivated area. Further, the main development, as has been seen, is in the direction of a peasantry built up of small, independent units. In these respects it is comparable to the Reserves of Kenya and it will be of interest to follow out the methods by which it is proposed to foster the growth of the exchange cultures which are necessary for the advancement of the country. Uganda suffers from one material disadvantage, its distance from the world's markets. It is a land-locked area with a long lead involving heavy transport charges and, consequently, its range of economic crops is more restricted than in more favourably situated countries. In practice the important exportable crops are cotton and coffee, the latter being grown mainly as a plantation crop on estates. Dominating the situation is cotton, the development of the cultivation of which has been rapid. The first export of cotton took place in 1904-05 when 50 bales were exported; in 1928-29 the export exceeded 200,000 bales of 400 lb. Cotton is an annual plant sown from seed and hybridization readily occurs; uniformity in the product has an important bearing on price; further, the raw product, seed cotton, is subjected to the preparatory process of ginning before the lint can be made into bales. The organization of its cultivation among a host of independent small cultivators offers peculiar difficulties if the desired uniformity of the product is to be obtained. The primary essential is purity of seed if the bulking of the small lots is to result in uniformity; secondly, grading and careful ginning must follow. In the early stages of this development the most profitable variety had to be determined and, since early efforts resulted in the dissemination of a number of different varieties of imported origin, an elimination of all but the best had to be undertaken. In 1909 the Government took complete control of the cotton industry under a Cotton Ordinance (Ord. 5 of 1908) which lays down that the Governor may make rules for maintaining and improving the quality of cotton either in reference to the distribution of seed or to the inspection of seed crops, cotton ginned and unginned, or ginneries or factories, and may prohibit the use of seed of any particular kind or specify any particular kind or kinds of seed as the only ones to be used or exported and may prohibit any method of sowing, collecting, ginning and otherwise preparing cotton. Power was also taken to make rules controlling purchase and sale of seed cotton. Full use has been taken under this comprehensive Ordinance to regulate all stages of cotton production and of the selling organization, and, under the latter head, cotton can only be sold at markets specified by Government.

In 1912 a Plant Pests Ordinance (Ord. 13 of 1912) was passed which appointed a special Board with powers, on the refusal of an owner, to enter

into land and take such steps as might be necessary to counter the pest, charging the cost to the owner.

These Laws are followed by a series of Rules and Laws the effect of which is to concentrate power still more in the hands of Government. Thus, in 1919 was passed the Buganda Native Cotton Law which laid down that :—

(1) Cotton is not to be planted mixed or in any other manner than that sanctioned by the Director of Agriculture ;
(2) Old cotton plants are to be pulled up before dates notified by the Director of Agriculture and on no account allowed to remain for more than one year ;
(3) Uprooted cotton is to be burnt as soon as possible ;
(4) It is unlawful to cut off bolls ;
(5) It is unlawful to plant cotton two years in the same plot.

Again, in 1926, a general Cotton Ordinance (Ord. 11 of 1926) was passed which gave the Governor power to prohibit the planting of cotton in any area and authorized the Director of Agriculture (1) to order destruction or to destroy cotton seed likely to harbour pests without compensation, the charges forming a debt, and (2) to notify when plants must be uprooted and destroyed by fire. It gave, further, to any officer of the Agricultural Department a right of entry on any land on which cotton is being grown.

Thus, by stages, the one important exchange culture of the country has come under intimate official control. It is the outstanding position of cotton in the economy of the country which is responsible for the attention devoted to it ; but the growing importance of coffee, of which production is partly native and partly plantation, and a low grade native product is likely to injure the reputation of the well prepared plantation product, has recently caused official action to be taken in the case of this crop also. In 1930 was passed the Coffee Growing Ordinance (Ord. 26 of 1930) which introduces a system of export licences. These are issued by the Director of Agriculture but he may authorize managers of estates to issue them with regard to their estate coffee and, in especial circumstances, to treat coffee not grown on their estates as so grown. Though one object was the control of theft, in this case, too, the first step is taken towards the official control of native production for export. This tendency is here as marked, perhaps more marked, as in Kenya.

It may be noted, in conclusion, that the above description is largely confined to the Buganda Province because it is in this Province that the land question has received the greatest attention. Elsewhere the same complexity of tribal development did not exist ; custom varies from tribe to tribe and it would take too long to consider each individually. In Toro and Ankole certain lands were, under the respective Agreements, allotted to Chiefs and, with the exception of these, all land is regarded as Crown Land ; elsewhere all land is held by the Crown and the general Ordinances of Uganda apply. The question of land, however, offers peculiar problems in each case, particularly in Bunyoro and Busoga, which have yet to be solved. In Bunyoro land is held under the kibanja system, a system having certain points in common with the Butaka system already described but with less definite rights and rights which were not recognized in any Agreement. Partly due to an innate desire to possess land but partly also under the stimulus of the observed developments in Buganda, a movement has arisen for the conversion of kibanja rights into personal grants. The question is still unsettled but has formed the subject of an enquiry in 1931 (8).

Nyasaland and Tanganyika.

The remaining areas of British East Africa offer few novel aspects of the land question, though communal ownership occupies a position of greater prominence. Development, too, has not been so rapid and a summary review is only necessary.

Nyasaland is a sparsely inhabited, land-locked country which was declared a British Protectorate in 1891 and received its present name in 1907. Owing to difficulties of transport, development has not been extensive but, in general tenor, that development has followed that of Kenya and an alien planting community has established itself. The absence of any highly organized tribes together with the period at which settlement commenced have led to an emphasis being placed on that aspect of tenure which affects settlement. The limited extent to which land has been alienated to non-natives has not yet rendered urgent the practical problems of native land. Among the more important Laws is the Crown Lands Ordinance (Ord. 15 of 1912) which regulates the method of disposal of Crown Lands exclusive of yearly tenancies and grazing leases to natives. Under it land might be sold in fee simple as 'grants' by auction at an upset price notified in the *Gazette* either to individuals or to firms and partners. Leases up to 99 years were permitted with revisable rental at the 33rd and 66th year, for slow growing crops such as tea and rubber and 21 year leases, with revisable rental at the 7th and 14th year, for non-slow growing crops. All leases were subject to implied conditions as to development and upkeep. In 1910 Registration of all documents purporting to refer to grants, transfers and leases had been made compulsory (Ord. 12 of 1910).

The earliest reference to native occupation is the Native Location Ordinance (Ord. 5 of 1904) which empowered the Governor to order up to one tenth of any undeveloped land to be set aside as a native location ; such location to be developed on communal lines under a Headman appointed by the Governor, each tenant paying 4s. per annum

rental. In 1917 a Native Rents (Private Estates) Ordinance (Ord. 16 of 1917) was passed which forbade taking service in lieu of rent and limited rent to an amount fixed by the Governor in Council. Payment of rent gave a title to sufficient land for subsistence crops and to materials for huts. In these Ordinances are the first indications of that question which developed so great an importance in Kenya; the method of organizing an estate labour supply. Here, too, this question has a growing importance and, in 1928, these two Ordinances were repealed by the Natives on Private Estates Ordinance (Ord. 15 of 1928). This comprehensive Ordinance follows the lines of the Kenya Ordinance in instituting permits for residence and it established a District Rent Board to determine the annual rental and terms of service. Of particular interest are the clauses which permit the growth of economic crops and compels the owner to purchase at market price sufficient to entitle the grower to a rebate of rent. The Board specifies what crops may be grown. Finally, the Governor is empowered to acquire compulsorily for native settlement an area not in excess of one tenth of private estates exceeding 3,000 acres (subsequently amended to 10,000 acres), giving Crown Land in exchange to an equivalent value.

Tanganyika.

The Land question in Tanganyika is complicated by the fact that, from 1885, when Germany established a Protectorate, to 1917, when British Civil Administration was established, the territory was under the control of Germany. The main legislation is the Land Ordinance (Ord. 3 of 1923) passed, and repeatedly amended in detail, "to protect existing customary rights and preserve native customs". In this youngest British Mandated Territory the change of emphasis dictated by the newer policy is well seen. This Ordinance declares all lands to be public lands without affecting the validity of any title earlier acquired, a proviso covering titles granted by the German Government. The Governor is empowered to grant "rights of occupancy" for a definite number of years not exceeding 99 and at a rental, compulsory in the case of a non-native, revisable after not less than 33 years, the rent being determined in the first instance by the highest bid at a public auction. Grants over 5,000 acres are subject to the approval of the Secretary of State. The certificate covering the grant carries certain implied conditions. Administrative officers are authorized to grant rights to natives for a term of years not exceeding five. On the death of a native occupier, devolution of rights is governed by the Deceased Natives' Estates Ordinance unless land is held in accord with native custom. Native interests are further protected by the prohibition of the transfer of land from the native to a non-native except with the consent of the Governor while, before a grant is made, the Administrative Officer enquires whether any native rights are affected (8).

REFERENCES.

(1) A copy of this agreement is to be found in the Handbook of the Uganda Question and proposed East African Railway; E. L. Bentley, *Chapman and Hall*, 1892.
(2) For Portal's Reports *see* C. 7303; Accts. and Papers, 1894, LVII, p. 641.
(3) Ann. Rep. for 1923; No. 1220, 1924.
(4) The Clan System, Land Tenure and Succession among the Baganda; W. M. Carter (undated).
(5) Ann. Rep. for 1930; No. 1556 of 1931.
(6) Ann. Rep. for 1930; No. 1551 of 1931.
(7) Ann. Rep. for 1926; No. 1377 of 1928.
(8) Rep. of the Committee of Enquiry into the Land Tenure and the Kibanja System in Bunyoro, 1931; Entebbe, 1932.
(9) Replies to the Mandates Commission; Ann. Rep. for 1923.

WEST INDIAN CATTLE.

By John Hammond. *Empire Marketing Board*, Report No. 58. *H.M.S.O.*, London.

Mr. John Hammond of the School of Agriculture, Cambridge University, visited the West Indies in the early part of 1930. His report which has just been received has therefore been somewhat delayed in presentation. He travelled to Jamaica and Trinidad on behalf of the Empire Marketing Board and although he was particularly required to study "the inheritance of milk yield, fat percentage, and other characters of cows cross-bred from Indian "Zebus", yet in the nature of things he found it necessary to see something of the conditions under which the cattle lived and how they fitted into the general agricultural economy of each colony.

The conditions are of course quite different in the two colonies. Jamaica has magnificent grazing lands and beef production is a large industry. In Trinidad the natural pastures are poor, cattle raising is in consequence a subsidiary industry and stall feeding is necessary. The report gives an account of the conditions in each colony and of the attempts that are being made in each place to raise the milking capacity of tropical livestock. The system of milk records initiated by Mr. H. H. Cousins, the Director of Agriculture, at the Hope Experiment Station at Kingston, Jamaica, has been thoroughly examined and the very complete records of the Government Stock Farm, St. Joseph, Trinidad, have also proved of value. In both places the conclusion has been arrived at, that pure European stocks are not likely to be able to stand up to tropical conditions and that a proportion of Zebu blood is essential. The correct proportion of Zebu blood that may be necessary is a problem that may be solved in a satisfactory manner by the interesting breeding experiments that are being carried out by Capt. H. V. Metivier at St. Joseph between Zebus and Holsteins.

The report is profusely illustrated and is valuable as a preliminary survey. A more detailed and scientific paper by J. Edwards on the conclusions arrived at has been published in the *Journal of Dairy Research* for May, 1932 (Vol. III, No. 2, pp. 281-293).

G. E.

SIERRA LEONE.

[*The following information about Sierra Leone, which is mainly of agricultural interest, was extracted from an article by G. T. Renner on the "Geographic Regions of Sierra Leone" which was published in Economic Geography, Vol. 7, No. 1, pp. 41-49.*]

Introductory.

SIERRA LEONE is a little enclave of British territory on the Guinea Coast of Africa, tucked in between French Guinea and the Republic of Liberia. Although Sierra Leone is approximately the size of Ireland, not more than 550 square miles of area are included in the colony proper, the balance of the 27,300 square miles constituting a protectorate attached to the colony. Sierra Leone is a compact little country and in its major environmental aspects is somewhat uniform throughout. Nevertheless, it manifests locally, striking enough differences in both natural environment and human life to warrant the recognition of at least three geographic regions, viz.: (*a*) The Coastal Bush Region, (*b*) the Central Forest Region, and (*c*) the Interior Savanna Region.

Coastal Bush Region.

The Coastal Region is a narrow strip of land, 10 to 40 miles wide. In the main it is low lying and level, crossed by nine large streams, intersected by estuaries and dotted by lakes and swamps. For half its length the coast is fringed by low barrier islands separated from the mainland by shallow lagoons. In addition, the Banana Islands, Turtle Islands, and several other small groups lie some distance off shore. The one exception to these general lowland conditions is the Sierra Leone Peninsula, where the country is composed of wooded hills, rising in one instance to an elevation of 2,494 feet. The climate of the coastal region is hot, humid, and rather unhealthy. As a result of the high temperatures, the heavy rainfall, and the shortness of the dry season, the region was originally covered with rain forest, but this has largely been destroyed by native farming and replaced by bush and jungle. Indeed, almost the entire region back of the mangrove forests, which fringe the lagoons and estuaries, may be described as bush land.

The dominant economic adjustment which the natives have made to their environment is along agricultural lines, but the system of culture involved is indeed a careless one. A native farm is made by clearing a space in the bush near the village. During the short dry season the debris is burned and the ashes scattered. Planting is done shortly before the rains commence and subsequent care is reduced to a minimum. After one crop is obtained, the land is, in many cases, abandoned. Millet, cassava, and sesame are widely grown, and hill rice has been cultivated on the dry land of the interstream areas since time immemorial. The soils in a few spots are wonderfully fertile, the alluvium of the mangrove swamps yielding extraordinary crops of wet rice. Most of this wet rice is produced on the alluvial areas of the Port Lokko and Skarsies districts, but is gradually spreading to the southern coastal areas. Some varieties of this wet rice are doubtless indigenous to the region, but it is known that the early missionaries introduced white American rice. Cotton is commonly grown for native weaving and fruits and vegetables for local consumption. There seems to be some indication of a systematic plantation agriculture, based on marketable staples, being worked out in this region. Some Ceara and Hevea rubber has been planted, but the attempts have not been very successful. Following the lead of Southern Nigeria and the Gold Coast, extensive cacao plantations have been created along the southern coast, but apparently the climate is not very suitable for cacao. However, its cultivation is being increased there, and Government nurseries are to be found in most of the villages. The fact that in 1927 some 77 tons of cacao were exported indicates that the venture may finally succeed. Coconut and pineapple planting along the coast likewise seems to offer some promise of success, but commercial cotton planting has been practically abandoned because of the havoc wrought upon that crop by the hot harmattan winds. The forest, which, in some near-by lands, is so important as a basis of economic activity, is of minor significance in this region. It is true that bananas, papaws, oranges, and limes grow in a wild or semi-wild state and are universally exploited, but they have no commercial significance. The cam wood trees yield a fine red dye and great quantities of this dye wood were exported during the war. The post-war competition of German aniline dye has however, completely annihilated this trade. Formerly, wild rubber (from the Landolphia vine) and gum copal were obtained from the forest, but owing to the reckless exploitation of the sources of these items, little of either is now produced. On the other hand, the piassava fibre (from the bamboo palm) is the best in quality in West Africa and is gathered and exported in considerable quantities. Even good building material is becoming so scarce that the Government is establishing forest reserves. Subsistence agriculture will always be important in this region, for the bulk of the population will have to be fed locally. The economic future must however depend upon the development of the production of staple commodities under a commercial plantation system. No great difficulties will be experienced in getting these commodities out to market, for the region is rather adequately served by rivers which are navigable from 20 to 40 miles inland by light boats and launches. In addition, the railway from the interior crosses the central part. Much experimentation, however, must be done in order to determine what crops are suitable to the climatic and labour conditions which exist.

Central Forest Region.

From the ninth parallel of latitude southward to the Coastal Region, the country is an undulating plain, sloping toward the sea and broken by isolated hills and ridges. The climate is apparently less bad than in the Coastal Region, but is rainy enough to support a heavy forest flora. Indeed, most of the central portion of Sierra Leone is covered with a dense, evergreen, tropical rain forest. Much of the soil is red laterite or light loam of several varieties. In places where the rain forest has been cleared, soil erosion is a serious problem. The population of the Central Forest Region is largely concentrated in villages, the sites of which have been invariably selected because of their nearness to good agricultural land. New villages are constantly being made, quite large ones having recently developed along the railway. Incidentally, this railway is unquestionably the most important single item in the Central Forest Region. The main line from Freetown runs for 230 miles eastward almost to the Liberian border, while a branch line extends for 104 miles northeastward into the chief area of oil palm forests. Hard-surfaced feeder roads converge upon the more important railway stations. The railroad has stimulated the growth of this region in both agriculture and nemoriculture. The latter in Sierra Leone consists mainly of the extraction of oil and kernels for export from the oil palms which exist in great numbers in the forest. Unfortunately, great quantities of oil palm trees are being destroyed to make room for rice farms. Rice culture is apparently spreading rapidly into the inland swamp areas under Government encouragement and distribution of free seed. The Government is fostering cotton growing also, by distributing quantities of American cotton seed. In fact, the colonial Government is actively encouraging all lines of agricultural industry. Through its agricultural department (started in 1912) an experimental farm is maintained near Mano, where the natives are taught rotation of crops, manuring, better hoeing methods and other much needed practices. In addition to field crops, small groves or orchards of kola trees occur in nearly every village. From these a very large export of kola nuts goes to Mohammedan Africa. Large as this export is, were better methods of growing and marketing employed, it might be enormously increased. Another industry giving promise of future development is the extraction of thymol from the omnipresent wild "bush tea" of Sierra Leone. The industry which perhaps gives the most promise of success in this region is the growing of ginger. It originated in the Orient but was probably introduced into Sierra Leone by ex-slaves from Jamaica. At first, it was grown only in the Coastal Section, but is now confined mainly to the Central Region, where it is universally grown. The poor and careless methods of preparation result in low prices and often loss of markets. In 1926 some 55,000 cwt. of ginger (valued at £76,000) was exported, while in 1927 only 27,000 cwt. (valued at less than £26,000) was marketed. At the Empire Exhibition at Wembley, Sierra Leone featured her ginger industry in the hope of stimulating intra-empire in that commodity. Particularly is Sierra Leone anxious to supply ginger to the Canadian manufacturers of ginger ale and to receive in return Canadian dairy products. This desirable arrangement will, however, never materialize until Sierra Leone achieves some measure of standardization in quality of its exported ginger.

Interior Savanna Region.

The country north of the ninth parallel of latitude is a confused mass of hills and grassy plateaux whose altitude varies between 800 and 3,000 feet. The soils are mostly derived from disintegrated gneisses and granites, and are usually of low fertility. Owing to the higher elevation the climate of this region is much better than that of the Central and Coastal parts of Sierra Leone; the rainy season is lighter and of shorter duration, the humidity is less and the temperatures somewhat lower. Savannas, or open, park-like forests, cover most of this region—great expanses of tall grass interspersed with low deciduous trees. The inhabitants are engaged in both agricultural and pastoral pursuits and some of them are skilled cattle raisers. Small red-brown cattle are bred throughout northern Sierra Leone, but their quality is very poor. A few horses are raised, but the tsetse fly hinders their increase in many districts. Goats and wire-haired sheep are to be found in practically every village. Agriculture in the interior Savanna Region is based chiefly upon millet, maize, and guinea corn. In addition some sisal, hemp, coffee, and castor beans are raised. In the north-eastern part of the protectorate, large quantities of peanuts are raised, and the cultivation of this arop is gradually spreading. This crop would cppear to offer great promise in the agricultural development of this region for the peanut is admirably adapted to the climatic factors in operation here and might furnish a large export in addition to playing an important part in native subsistence economy. Travel in the Northern Savanna Region is invariably by trail or bush track and transportation is furnished solely by native carriers. It is no wonder then that this region is but little known and exports practically nothing save a few hides and skins.

Economic Future.

As late as 1923, the Annual Colonial Report stated that while Sierra Leone had been examined by a geologist, no minerals of any commercial value had been found. However, a rather careful survey in 1926 resulted in the discovery in the Marampa section of valuable deposits of hematite. It was estimated that seven million tons of low phosphorus—low sulphur ore which would run 61 per cent. Fe.—was in sight, with a strong

likelihood of 20 to 50 million additional tons of fairly good ore in existence there. In addition, the protectorate possesses great resources in water power. As a result, some manufactured and saxicultural adjustments may ultimately be made, but the secret of economic success here, as elsewhere in the tropical lands of Africa, lies in inducing the natives to work so as to exploit the natural wealth of forest and soil. If this can be done, Sierra Leone can produce large quantities of key raw materials. The Interior Savanna Region can contribute peanuts and animal products; the Central Forest Region, palm oil and kernels, ginger, and cotton; and the Coastal Bush Region, cacao, rice, piassava, and possibly rubber and fruits.

INDUSTRIES OF WEST, EAST AND CENTRAL AFRICA.

[The following article is reprinted from "Chemistry and Industry" (Vol. 51, No. 25), to which due acknowledgment is here made.—EDITOR.]

AT the end of 1930, Messrs. Erlangers, Ltd., the bankers, of Moorgate, London, E.C. 2, published the first of a series of monographs on "The Manufacturing Industries of the British Empire Overseas". With the issue of a volume on West, East, and Central Africa, Messrs. Erlangers have now completed their task, and have covered the whole of the field, with the exception of the Irish Free State, India, and a few outlying countries in the Pacific.

With the exception of the Union of South Africa, no British country in Africa has developed to any degree any manufacturing industries save those which entail the primary treatment of raw materials.

Production.

A remarkable feature in the production of the countries which form part of the British Empire in Africa is the diversity of their products, for, with one exception, in no case is the principal product of one country the same as that of any other country. The following table illustrates this point:

Country.	*Export productions in 1930.*	*Principal products.*
	£	%
Gambia	878,284	Groundnuts 98.79.
Sierra Leone	1,047,339	Palm kernels 63.5, kola nuts 17.73, palm oil 7.56, ginger 5.48, piassava 3.5.
Gold Coast	8,855,054	Cocoa 70.33, gold 10.66, manganese 8.3, diamonds 6.64.
Nigeria	14,777,883	Palm kernels 25, palm oil 22, groundnuts 14.9, cocoa 11.8, tin 9.3, hides 5.9, cotton lint 4.2.
Southern Rhodesia	5,633,836	Gold 38.4, asbestos 11, chrome ore 7.8, cattle for slaughter 6.2, tobacco 5.4, coal 4.7, maize 4.5, coke 1.9, maize meal 1.6, citrus fruits 1.5, ox and cow hides 1.5.
Northern Rhodesia	768,848	Zinc 44.5, copper 29.3, tobacco 7.5, gold 3.5, vanadium 3.2, wood 2.2, maize 1.5.
Nyasaland	663,427	Tobacco 73, cotton 11, tea 8.5, sisal 4.5.
Kenya and Uganda	5,483,024	Coffee 28.8, cotton 28.6, maize 10.3, sisal 7.7, carbonate of soda 4.1, hides 3, cotton seed 2.5, wheat 1.7, wool 1.3.
Tanganyika	2,635,974	Sisal 44.6, coffee 15.05, cotton 9.4, groundnuts 7.1, hides and skins 4.7, copra 4.2.
Zanzibar	1,093,075	Cloves 67, copra 22, clove stems 2.2.
South West Africa	2,540,487	Diamonds 46.5, copper 16.75, hides and skins 6.5, vanadium 5.9, animals 3.75.
British Somaliland	250,114	Sheep and goat skins 37, live stock 31, coffee 11, ghee 10, gums and resin 8.1.
Anglo-Egyptian Sudan	5,082,214	Cotton (ginned and seed) 65.7, gum arabic 19.8, cattle, sheep and hides 4, sesame 3.2.
Union of South Africa	83,409,477	Gold 43, specie 12.3, wool 10.3, diamonds 6.6, maize 2.9, sugar 1.8, sheep skins 1.3, wattle bark 1.03.

The West Coast of Africa is responsible for nearly 60 per cent. of the world production of cocoa, palm oil, and palm kernels. Zanzibar has virtually a monopoly in cloves. Tanganyika and Kenya produce about a quarter of the world's supply of sisal.

West Africa.

The product of the oil palm forms 71 per cent. of the domestic exports of Sierra Leone and 47 per cent. of those of Nigeria. Oil extracted from a plantation palm can be manufactured of a standard quality and with a percentage of free fatty acid which need never exceed three or four per cent. The product of West Africa extracted from the indigenous palm can be manufactured of a standard quality and with an equally low percentage of fatty acid, but to effect this end the fruit has to be treated within a few hours of its being plucked from the tree. As the oil-mill owners have to buy their supplies from the natives, who cannot be educated sufficiently to deliver

their nuts with regularity and within the limit of time necessary to extract the best quality of oil, there can be no certainty as to when the nuts were gathered, and therefore no certainty as to the quality of the oil that will be extracted. In the present circumstances although native labour costs but 8*d.* a day, it does not pay to keep oil-extraction mills in operation. Of the two on the Gold Coast, one is closed down, and the only mill in Nigeria is no longer operating. In British and French Cameroons four mills are working, using fruit from semi-plantation palms, but at the present prices of palm oil and palm kernels, it is very doubtful if these show any adequate return.

The United Africa Co., Ltd., is making a practical test of plantation palm trees in British Cameroons, where they have laid out 4,500 acres at Ndian. They have used the best selected seeds and are cultivating the palms on the most modern methods.

Gambia is taken up wholly with the cultivation of groundnuts. The present price of cocoa has short-circuited the current of commercial life on the Gold Coast. Palm products are the life-blood of Sierra Leone and the present price hardly pays for the handling of its products. Nigeria is slightly more diversified in its cultivation, but oil nuts and cocoa account for nearly 75 per cent. of its export wealth, and it will have a hard struggle to convert its native population to adopt the cultivation of other products, when to-day they have merely to pluck a forest fruit.

Southern Rhodesia.

Southern Rhodesia has a steady mineral production, the deposits of asbestos and chrome ore being of special value. So far her deposits of asbestos have only been scratched, yet Rhodesia is the second producing country in the world, and is already the largest producer of the better grades. The following statement of her mineral output is taken from the report of the British South Africa Co.:

Years ended 30th September.		1929.	1930.	1931.
Gold	*oz.* ..	556,375	551,759	529 141
Coal	*short tons* ..	1,110,932	1,131,490	725,946
Chrome-ore	*do.* ..	255,081	291,507	93,864
Asbestos	*do.* ..	39,612	41,515	31,570
Copper	*tons* ..	....	1,484	947
Other minerals	*value £*	85,469	46,736	44,633

Northern Rhodesia.

Northern Rhodesia has a future as a potential source of supply of copper for the Empire and the world. At the present moment the only copper mines at work are Roan Antelope and N'Kana.

If the price of copper is to remain at anything like its present low figure, the Nothern Rhodesian mines are amongst the few that are certain to survive, in that their costs of production are very low, and possibly leave a margin of profit even at to-day's figures.

The following is a statement of the mineral output of Northern Rhodesia as taken from the report of the British South Africa Co.:

Years ended 30th September.		1929.	1930.	1931.
Gold	*oz.* ..	970	5,403	9,158
	value £ ..	4,120	22,952	38,902
Copper	*tons* ..	5,729	6,422	3,337
	value £ ..	417,838	393,719	140,392
Copper concentrates	*tons* ..	20	999	20,487
	value £ ..	548	12,174	185,890
Zinc	*tons* ..	12,833	19,518	13,932
	value £ ..	314,955	347,153	171,782
Lead	*tons* ..	3,163	Nil	Nil
	value £ ..	64,537	....	....
Vanadium	*lb. of vanadium content*	58,573	202,957	321,061
	value £ ..	12,647	43,821	94,783
Other minerals	*value £*	92,192	* 37,621	2,489
Total values	*£*	906,837	857,440	634,238

Owing to adverse market conditions, zinc production was stopped at the end of June, 1931, and the Broken Hill Mine is limiting its output to fused vanadium oxide and vanadium concentrates. Rhodesia can produce zinc at an extremely low figure, but with spelter at to-day's price of about £12 15*s.* 0*d.* per ton, it is impossible to work at a profit, even though Broken Hill turns out electrolytic zinc which fetches about 30*s.* per ton above the price of ordinary market brands. As steps have been taken to curtail output and stocks are approaching a normal figure, it is to be hoped that the price of spelter will improve so that the production of zinc may recommence.

Kenya.

In 1930 Kenya exported 49,270 tons of sodium carbonate, valued at £222,300.

* Figures adjusted.

RICE DISEASES.

Sclerotial Diseases of Rice.

Investigations by Messrs. Malcolm Park and L. S. Bertus at the Royal Botanic Gardens, Peradeniya, Ceylon, (*Ann. Roy. Bot. Gardens*, XI, pt. 4) reveal that *Rhizoctonia* (*Corticium*) *Solani* not only gives trouble in the potato fields of England, but also causes a disease of rice in Ceylon. It has been found that the ordinary methods of crop rotation are inadequate owing to the longevity of sclerotia in soil. Experiments are, however, being directed towards finding a specific soil treatment. The other disease investigated is caused by *Sclerotium Oryzae*. This occurs in patches in the rice-growing areas. Methods of control consist in the burning of diseased patches at harvest time and in preventing irrigation water from running through a diseased field since it might carry infection. It has also been found possible to grow varieties of rice which are resistant.

REVIEWS.

Soils, their Origin, Constitution and Classification.

By G. W. Robinson (Univ. College of North Wales); *T. Murby and Co.*, London, 1932, 20s. pp. 390.

This book furnishes an introduction to Pedology, which is defined as "the study of the soil from the standpoint and by the methods of pure science", and which, in one aspect, is a branch of geology; in another, the physics and chemistry of a complicated colloidal system, and in a third, a branch of ecology. The author points out that, because Pedology ought to be regarded as an independent study, the view implies no depreciation of the practical significance of the subject, since the elucidation of the origin and constitution of soil, and the development of a philosophical system of soil classification, are bound eventually to prove usefully applicable to agriculture.

The order of presentation and the scope of the subject matter are indicated by the following main chapter headings: (Ch. II) General View of the Constitution of the Soil (mineral composition, the clay fraction, soil organic matter, the soil solution, soil air, soil structure); (Ch. III) The Pedogenic Processes (chemical weathering, soil profile development, soil erosion, the effect of vegetation); (Ch. IV) The Clay Complex (nature, composition, formation); (Ch. V) Base Exchange and other Reactions of the Clay Complex (degree of base saturation, exchange capacity, soil reaction); (Ch. VI) Soil Organic Matter (decomposition of plant residues, humification, nitrogen cycle); (Ch. VII) Physical Properties of Soils; (Ch. VIII) Water Relationships; (Ch. IX) Soils of the Podsolic Group (podsolisation, brown earths, English soils, prairie soils, mountain soils); (Ch. X) Tshernosems (black earths, chestnut soils, desert soils); (Ch. XI) Ground-water Soils (meadow, peat, vlei, black prairie soils); (Ch. XII) Saline and Alkaline Soils: (Ch. XIII) Soils of the Humid Tropics and Sub-Tropics (red earths, yellow earths, laterite Soil); (Ch. XIV) Soils associated with Calcareous Materials (rendzinas, limestone soils); (Ch. XV) Classification of Soils; (Ch. XVI) Geography of soils; (Ch. XVII) Soil Surveys; (Ch. XVIII) Soil Analysis; (Ch. XIX) Soils, Plant Growth, and Agriculture, and (Appendix), Methods of Analysis.

A short list of selected references follows each chapter, and indexes to places and to subjects concludes the book. There are twelve good illustrations, and numerous tables of data.

More than one-third of the book (Ch. IX to Ch. XVI) deals with the great soil groups of the world and their distribution. This section is a notable contribution to English soil literature, and supplies a long-felt want. The treatment here is broad yet concise, and the writing, lucid and attractive. Whilst the rest of the book presents very readable summaries of our knowledge of the various aspects of soil science, serious students (especially those whose work concerns tropical agriculture) will perhaps derive most benefit from the section that describes natural soil types. The reviewer has no hesitation in strongly recommending this book to all who desire to learn more about the natural history of soils and about soil-forming processes, for its scope has nowhere yet been covered by any other work.

F. H.

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Farm Management in South Africa.

E. Sewell Dawson. S. African Agricultural Series No. 9. *Central News Agency, Ltd.*, S. Africa. pp. 336, price 22s. 6d.

In an introduction to this book, the writer, who is the Manager of the Pretoria University Experiment Farm, states that it is intended to present to the working farmer the elements of farm economics in a simple and understandable manner. Such a book should meet a distinct want, for as the author points out, farming conditions in South Africa are not so stereotyped as in older countries, and are, even so, in a state of transition at present, owing partly to the exhaustion of much of the soil, and partly to the change in relative values.

The book should therefore prove most useful to all those engaged in farming in South Africa. It is, of course, written primarily for them, but it deserves a wider appeal, and with this in mind, a more uniform system of weights and measures might be employed; on two successive pages (296-297) the yield of maize is expressed as bags per morgen, bags per acre and bushels per acre, nor is it easy to find out the number of lb. in a bushel, or the area of a morgen.

There is evidence that there is still some divergence of opinion as to the advisability of veldt burning. In *Dept. Agri. Sci. Bull.*, No. 49 (1926), controlled burning with a view to encourage the growth of the superior grasses was advocated, but the present author writes that it is not a practice to be recommended, though it may occasionally be a necessity. It is probable that conditions vary widely throughout the Union.

The illustrations are good, though not essential to the argument, and even when they are taken into account, the cost of the book appears heavy.

R. C. W.

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The New Age West Indian Geographies.

By L. Dudley Stamp & A. J. Newman. Book I, pp. 92, 1s. 4d. Book II, pp. 122, 1s. 6d. Book IV, pp. 160, 2s. 3d. *Longmans, Green & Co., Ltd.* 1932.

While the first two books are well-written geographies for preparatory schools, Book IV, might well find a place in the tourist's luggage, for it is concisely worded, liberally supplied with photographs and sketch maps, and it includes the British, French, Dutch, and United States West Indies, as well as British Guiana, Central America, Cuba, Haiti and Mexico.

D. W. D.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Relation between Fineness of Limestone Particles and their Rates of Solution. *Bear and Allen.*

The authors have worked out a method for evaluating ground limestone from the point of view of its effect on soil acidity. They adopt a standard particle size and compare all other sizes with this. Working with Tyler standard screens, it was found that 48-65 mesh high-calcium material applied at the rate of 1¼ tons per acre will bring about a maximum decrease in soil acidity after about twenty-four months, allowing for a certain amount of leaching. In terms of field practice, the experimental data from plots indicate that if it were desired to produce the same effect on the soil reaction by the end of twelve months, it would take practically ten times as much of 4-6 mesh material as of 48-65 mesh material.—(*Ind. and Engin. Chem.*, Vol. XXIV, 1932, No. 9, p. 998.)

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Paper from Straw or Bagasse. *V. Pomilio.*

A method has been applied commercially in Argentina for producing cellulose from straw, cotton stalks, bagasse, or esparto grass. The procedure is a modification of the Cross and Bevan method of estimation of cellulose by decomposing the non-cellulosic materials with chlorine gas. The method in brief is as follows:—The raw material is first treated with a weak alkaline liquor (about one per cent. sodium hydroxide) at 80° to 90°C., and the excess liquid is pressed out. The next step is to saturate the material with chlorine gas under controlled conditions, and the chlorinated non-cellulose compounds are washed out with dilute alkali.—(*Ind. and Engin. Chem.*, Vol. XXIV, 1932, No. 9, p. 1006.)

* * *

Powdered Rubber from Latex.

Two patents for preparing powdered rubber from latex have been taken out by the Stam Laboratory, Holland. The first of these gives details of a method for covering the surfaces of articles with rubber and other latex products. Powdered latex, after being mixed with dry-filling, dyeing, and other substances, is worked into a paste with a liquid that has no solvent action on the rubber, and after the addition of vulcanizing catalysts the paste is applied to the surfaces of the articles. The second patent gives particulars of an apparatus for drying to powder milky liquids, solutions, dispersions, and emulsions, employing a centrifuging vessel from which the liquid is sprayed in a pulverising room. (*Chem. and Ind.* Vol. LI, 1932, No. 39, p. 799.)

Removal of Added Nitrogen from Grassland Soils.

In a letter to *Nature* of 16th July, 1932, H. L. Richardson gives a preliminary account of experimental work at Rothamsted on the rate of removal of added nitrogen from grassland soils. In applying nitrogenous fertilizers it is important to know how much of the readily available nutrients are being taken up by the plant before there is time for leaching to take place.

The author finds that nitrogen added to grassland soils, whether as ammonia or as nitrate, is removed very rapidly. The measure of rate of removal was taken as the interval required for three-quarters of the added nitrogen to disappear from the soil. With early spring and late autumn dressings of sulphate of ammonia, applied at times when the herbage is probably almost dormant, the interval required was about three weeks, while heavy dressings of the same fertilizer in mid-spring gave an interval of seven days. In late spring, the period of maximum growth, the time required was only two days. There was no appreciable accumulation of nitrate in the soil after any of these applications of sulphate of ammonia.

With nitrate of soda the disappearance was even more rapid—the corresponding intervals being three days in mid-spring and less than two days in late spring.

In fertilizing grassland, therefore, there is considerable risk of leaching, but this is partly counteracted by the fact that the plant has an extremely high rate of uptake, and Richardson puts forward the view that grass is able to assimilate ammonia directly without previous nitrification.

* * *

Nitrite Content of Sodium Nitrate.

An examination has been made in France of a number of samples of nitrate of soda obtained from various sources, in order to determine the amount of nitrite present in each. The examination was made following farmers' complaints that certain nitrates, on mixing with other fertilizers, gave off disagreeable gases. Whereas ordinary Chilean nitrate was found to contain 0.003 gms. per kg. of sodium nitrite, and a granulated sample 0.025 gms., some synthetic sodium nitrates from America were found to contain more than 1 gm. of nitrite per kg., whilst some German samples also gave higher nitrite contents than those of the Chilean nitrate.—(*Chem. and Ind.* Vol. LI, 1932, No. 39, p. 800.)

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Tung Oil.

The first tank car load of plantation-grown tung oil produced in America was recently shipped from the plant owned and operated by the Alachua Tung Oil Co., Gainesville, Ga., a subsidiary of Benjamin Moore and Co.—(*Ind. and Engin. Chem., News Edit.* Vol. X, No. 11, 1932, p. 153.)

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Potassium Deficiency in Sugar-Cane.

In a paper by C. E. Hartt in the *Botanical Gazette* (Vol. LXXXVIII, No. 3) investigations are described in which cane cuttings were planted in soil with different amounts of potash salts, and the plants arising therefrom were subjected to an extended series of analyses and micro-chemical examination. Those plants suffering from a deficiency of potash showed decreased growth, die-back, and deficiency in chlorophyll development; such plants also developed longer roots than those better supplied with potash.

The tops of potassium-deficient plants showed less moisture than did the controls. Potassium-deficient plants had greater percentages of total sugars, reducing sugars, and sucrose than had the plants which were supplied with potassium. Greater lignification occurred in the potassium-deficient plants, greater cutinization in the potassium-adequate plants. Lack of potassium was associated with abnormal distribution of the root-pith vessels, small size of vessels and parenchyma cells in the stems, large cavities in the root cortex, and underdevelopment in the root hairs.

Suggestions are offered as to the various causes of the symptoms of potassium starvation, also as to the greater resistance to low temperatures and diseases in plants supplied with potassium, and as to the linking into a chain of cause and effect of several derangements which are noted.—(*Facts About Sugar*, Vol. XXVII, No. 6.)

* * *

Fertilizing Sugar-Cane in Australia. *H. W. Kerr.*

In the *Queensland Bureau Sugar Experiment Stations Farm Bulletin* No. 3 (1931), entitled "Farm Fertility Trials", results are given of 47 field experiments with fertilizers made on farms scattered throughout the Queensland sugar-cane districts; 16 of the experiments were harvested both as plant and as ratoon crops. The results are variable but it appears that the red volcanic soils respond chiefly to potash, while the acid alluvial soils require heavy dressings of phosphates. Practically all soils respond to nitrogen; although the plant crop may not show much benefit, the ratoons almost certainly will do so. As much as 400 pounds of nitrogen is reasonable on ratoon crops in some cases.

As regards the effect of fertilizers on the purity of the cane juices it is noted that sulphate of ammonia tends to delay ripening while potash accelerates maturity.

In some cases it happened that dry weather in the plant cane year prevented the crop from deriving benefit from the fertilizer, but where the following season was wet the ratoon crop benefited in a decided degree.—(*Facts About Sugar*, Vol. XXVII, No. 8.)

Molasses as a Fertilizer. *H. W. Kerr.*

The problem of the economic disposal of sugar cane molasses in a country like Australia is a serious one. In the past much molasses has been run to waste, with resultant pollution of rivers, destruction of fish and menace to public comfort and health. The distillers have been able to absorb only a limited portion of the output and the sale of molasses as a stock feed fluctuates considerably and brings a good return only in times of drought when other feeds are scarce. Some mills use large quantities of molasses for fuel, and the Bingera plantation has experimented on a large scale with molasses as a fertilizer.

When applied in diluted form to pasture lands, its first effect is to kill the grass and other vegetation; later, however, a luxuriant growth of excellent pasture, principally *Cynodon dactylon*, is obtained. On cane lands it was found that light applications of molasses in irrigation water could be made without injury to soil or cane, and high yields were obtained. Very satisfactory results were also obtained by distributing undiluted molasses along the lines of stools, out of the way of cultivating implements. It is possible to spread up to 30 tons of molasses in eight hours on fields within a two-mile radius of the mill, using a motorized tank holding 2,500 lb. Molasses fresh from the centrifugals is the easiest to handle.

Ratoon crops respond well to molasses fertilizer, the response varying with the character of the soil. Extraordinary increases of yield were obtained from volcanic soils known to be deficient in potash. When undiluted molasses is put on the fields its decomposition is effected chiefly by moulds and other fungi. When diluted, it is decomposed chiefly by yeasts and bacteria, with much loss of carbon in the form of carbon dioxide gas.—(*Inter. Sugar Jour.*, Vol. XXXIV, No. 404.)

* * *

Rayon from Bagasse.

Using low-priced nitric acid, chemists of the United States Department of Agriculture have developed a process for making high-grade cellulose from bagasse, the waste from sugar-cane after the sugar has been extracted. These experiments, carried out by the Colour and Farm Waste Division of the Bureau of Chemistry and Soils, produced a higher percentage of high-grade cellulose from bagasse than any previous attempts. The method, known as the nitric acid pulping process, consists of soaking the raw material in a weak nitric acid solution for several hours at a medium temperature, then heating it for an hour, and finally washing and boiling in dilute sodium hydroxide to produce a soft bleachable pulp. Cheaper supplies of nitric acid make the process commercially feasible. Some of its advantages as compared with older methods of processing bagasse are that open tanks are used instead of pressure tanks, and that it takes less heat, power, and time. No statement of yields and costs has been made.—(*Facts About Sugar*, Vol. XXVII, No. 6.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR:—Prices on the Home Market have ranged as follows (c.i.f. per cwt.):—

	Foreign.	*Preferential.*
	s. d.	*s. d.*
29th Sept. ..	5 10½	10 7½
6th Oct. ..	5 10½	10 7½
13th Oct. ..	6 0	10 8¼
20th Oct. ..	5 10½	10 8¼
27th Oct. ..	5 9	10 6
3rd Nov. ..	5 9¾	10 7½
10th Nov. ..	5 10½	10 7½
(*12th Nov.*, 1931) ..	6 6	10 3

There have been no developments of outstanding interest since our last report, the tone of the market remaining generally steady. The chief features have been the signing by the Cuban President of a further Decree providing the extension of the period of segregation of 700,000 tons of sugar to 1st July, 1933, and the publication of Licht's first estimates of the 1932-33 European crop. Whilst there is apparently no prospect of any actual shortage in sugar in America, it is believed that a material improvement in the statistical situation may eventually occur. Licht's estimates have merely served to confirm Mikusch's figures. It is of interest to note from the United Kingdom trade returns for September that the British West Indies imports were 13,662 tons as against 263 in 1931.

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COCOA.—The cocoa market has been upset by the arrival of unexpected large quantities of cocoa from Bahia. It was anticipated that this crop would be from 15 per cent. to 20 per cent. short, but after the Revolution large quantities of cocoa were marketed. The market is quiet and prices in London are as follows:—Trinidad fine Plantation, 43*s.* to 51*s.*; Grenada, 34*s.* to 38*s.*; Samoa, 65*s.*; Costa Rica, 30*s.* to 31*s.* Superior Summer Arriba, 70*s.* to 72*s.* 6*d.*; Venezuela fine bold unclayed, 82*s.* 6*d.* to 87*s.* 6*d.*, fine clayed 75*s.* to 80*s.*; Maracaibo fine bold, 108*s.*; Accra, 26*s.* to 30*s.* Locally the market is quoted at $7.00 a fanega.—(*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)

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BANANAS.—Jamaicas are in quiet demand and unchanged at £20 5*s.* per ton delivered London, and £20 nearest railway station. Brazilians are in poor demand, and £1 10*s.* per ton lower at £17 10*s.* nearest railway station.

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association:—

	American Mid.	*Egyptian F.G.F. Sakel.*
30th Sept. ...	5.73	8.35
7th Oct. ..	5.84	8.30
14th Oct. ..	5.43	7.97
21st Oct. ..	5.46	7.88
28th Oct. ..	5.62	—
5th Nov. ..	5.55	—
(*6th Nov.*, 1931) ..	5.03	7.55

Prices have shown a tendency to decline although the undertone of the market has on the whole, been steady. Latest quotations for West Indian Sea Island ranged from 14.50*d.* to 15*d.*

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COPRA is a quiet market and values are lower. West Indian f.m.s. is quoted at £14 17*s.* 6*d.* net, spot and £15 2*s.* 6*d.* for forward.

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LIME PRODUCTS.—*Lime Oil.*—Fair sales of good quality Handpressed have been made at 45*s.* per lb. Distilled is quiet with unimportant sales. Prices are irregular and quotations misleading, pending some definite crop information. *Lime Juice.* There is no market for Concentrated. There is more doing in Raw, and sales have been made at 2*s.* 3*d.* to 2*s.* 6*d.* on spot for good Dominica to fine Jamaica.—(*West India Committee Circular*, 13th October, 1932.)

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TEA.—The market for Indian, Ceylon and Darjeeling tea has been gaining in confidence, latest averages being Ceylon 11.07*d.*; Indian 8.66*d.*; Darjeeling 19.17*d.*; Java is quoted at 5.78*d.*

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COFFEE.—The market has been steady with Brazilian in better request. Jamaica has ranged over a variety of sales from 80*s.* to 203*s.* and Kenya from 72*s.* to 118*s.*

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RUBBER.—Quotations from Plantation Sheet have ranged as follows:—

	d.
28th Sept.	$2\frac{21}{32}$
5th Oct.	$2\frac{1}{2}$
12th Oct.	$2\frac{7}{16}$
19th Oct.	$2\frac{7}{16}$
26th Oct.	$2\frac{1}{2}$
2nd Nov.	$2\frac{15}{32}$
9th Nov.	$2\frac{9}{32}$
(*11th Nov.*, 1931)	$2\frac{5}{16}$

The rubber market by following the course of other markets which seem to be dependent very largely on American politics, has been dull and rather inactive. Any improvement in the price of American produce, particularly grain and cotton, is likely to affect rubber as the potential replacement demand for both cars and tyres depends very largely on the prices realised for American agricultural produce. Latest statistics show that whilst United Kingdom rubber stocks are declining, American stocks are accumulating,